February 1944

TECHNOLOGY REVIEW

Title Reg. in U. S. Pat. Office

"Must" for Aviation

TOOL GRINDING

Skill plus correct Grinding Wheel

Your "must"—the skill for a cutting-tool conditioning.

Norton's "must"—to give your skilled men correct working equipment—grinding wheels developed for each job of the shape, size and cutting qualities that best meet the conditions.

The Norton special 38 Alundum abrasive was one of the results of research to solve the problem of grinding of the kind required in the tool room. The Norton BE bond is another that has proved of inestimable importance in tool-room grinding.

Up to the present time, you need look no further for abrasive and bond satisfaction, but you, too, may benefit from the Norton knowledge of shop performance on the variety of cutting-tool metals in use.

NORTON COMPANY, Worcester 6, Mass.

Behr-Manning, Troy, N. Y., is a Norton Division

Photo courtesy North American Aviation, Inc.

NORTON ABRASIVES

He had no peer as a Tool Maker... *until he lost an eye*

...all workers on or near Eye Hazardous Jobs need AO GOGGLES

Are the highly skilled men in your plant wearing goggles? The price of the finest pair of AO Goggles is trifling compared with the loss — even for half a day—of the services of one of your skilled men.

An adequate eye protection program that provides AO goggles for every man and woman who works on or near an eye hazardous job will pay for itself in a few months. AO Goggles are designed to give maximum protection and workers find them comfortable to wear. Ask your Safety Director to get in touch with the American Optical Company's branch office nearest you.

American Optical

COMPANY

SOUTHBRIDGE, MASSACHUSETTS

Manufacturers for more than 110 Years of products to Aid and Protect Vision. Branches in all principal industrial centers

THE TECHNOLOGY REVIEW, February, 1944. Vol. XLVI, No. 4. Published monthly from November to July inclusive at 10 Ferry Street, Concord, N. H. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription $4.00. Entered as second-class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.

"PUT IT ON THE BLANCHARD"

Grinding Main Housing Poles for Magnetos on a No. 18 Blanchard Surface Grinder

Ability to remove metal quickly and cheaply makes it possible for Blanchard Grinding to carry through from roughing to finishing in one operation.

These Housing Poles for magnetos have .140" stock to remove from steel laminations. Ten pieces are held on a Blanchard designed fixture on the No. 18 Grinder and 30 pieces are finished per hour.

The weight and rigidity of the Blanchard are essential for economical machining of parts such as these.

CHECK THESE ADVANTAGES OF BLANCHARD GRINDING

- ★ Production
- ★ Adaptability
- Fixture Saving
- ★ Operation Saving
- Material Saving

- Fine Finish
- Flatness
- Close Limits
- ★ . . . . *Especially valuable on jobs like the one illustrated.*

The BLANCHARD MACHINE COMPANY

64 STATE STREET, CAMBRIDGE 39, MASSACHUSETTS

BLANCHARD

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

A New Type of Ship Follows Her ...with the Same Type of Diesel

Below is a picture of the U. S. Maritime Commission ship American Manufacturer. She is one of the C-1 vessels propelled by Busch-Sulzer Diesel engines. The C-1's are giving a good account of themselves, delivering war cargoes on fighting fronts the world over.

Now a new type of Maritime Commission vessel will carry the battle to the enemy—the C1-MAV-I. Busch-Sulzer is proud, of course, that its Diesel engines on C-1 ships made a reputation that has earned them the privilege of powering the new vessels. That reputation stems from nearly half a century of producing Diesel power noted for low operating cost, low maintenance cost and reliability. These factors will be offered to you when Victory ends our present schedule of 'round the clock production for the Army, Navy, Maritime Commission and high priorities only.

BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY
SAINT LOUIS

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BUSCH-SULZER
ST. LOUIS

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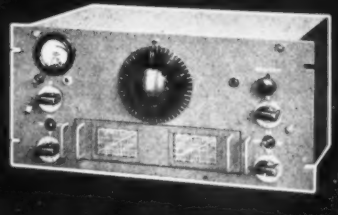
AMERICA'S OLDEST
BUILDER OF
DIESEL ENGINES

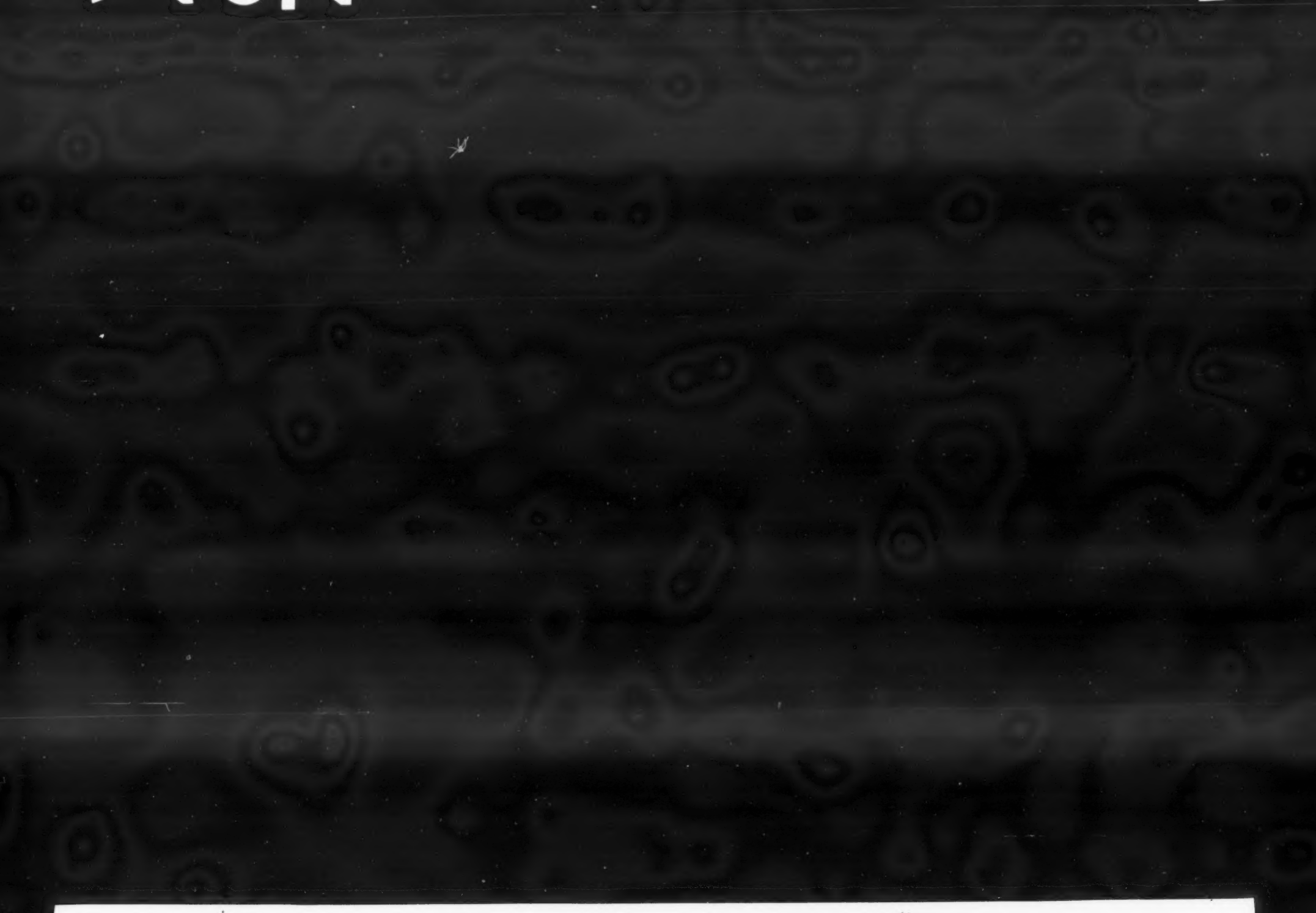
MEDIUM TANK, M-4
PHOTO BY
US ARMY SIGNAL CORPS

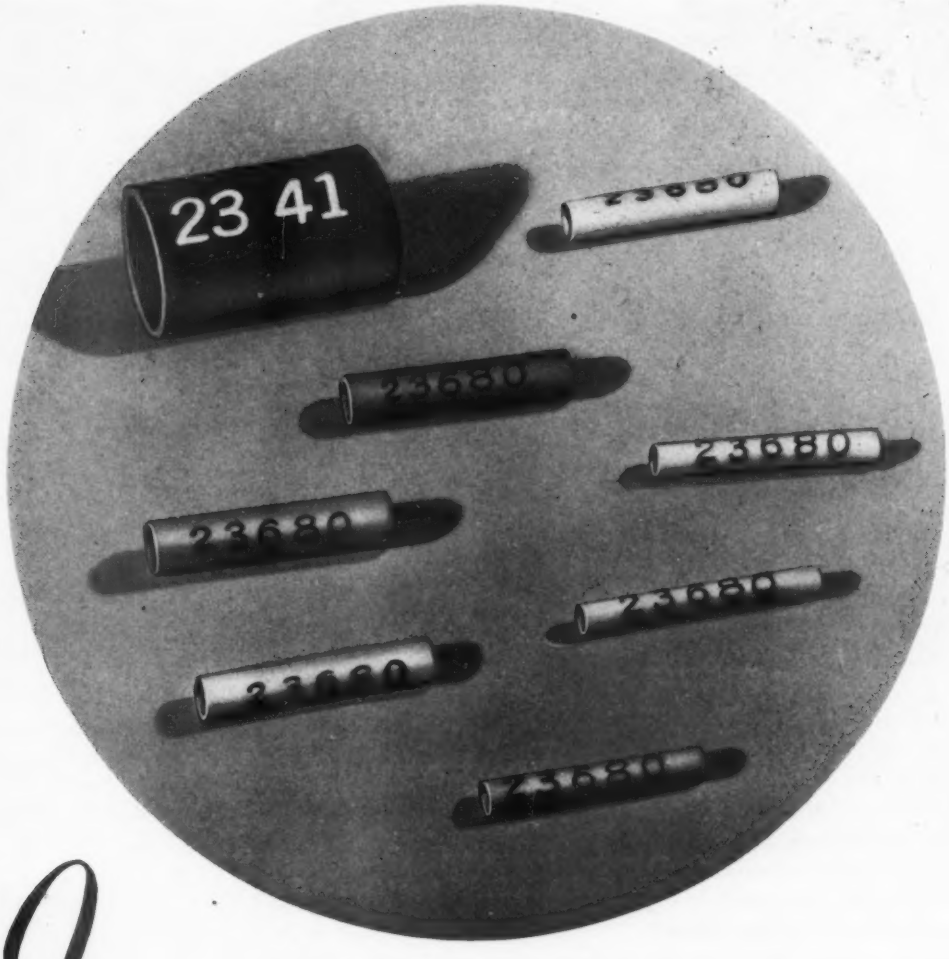
BUTTONED DOWN *and ROLLING*

Rolling all over the world. Hitting the enemy where it hurts him the most, covering infantry, scouting, fighting. Fighting and talking. Talking by radio to coordinate all in a pattern of Victory.



NATIONAL COMPANY, INC.
MALDEN, MASS.





Imprinted TERMINAL INSULATORS AND IDENTIFICATION SLEEVES

THE identification of various electrical wires and cables is now a quick, easy job. For, Sandee Vinyl Sleevings (made in all standard sizes) can now be cut to any lengths from ¼" to 6½" and imprinted with identification marks or numbers! Sandee Vinyl Sleevings are obtainable in all N.E.M.A. colors as well as black, white, and clear.

Electric wire and cable insulated with SANDEE compounds offer such advantages as:

1. High stability
2. High resistance to weathering conditions
3. Moisture absorption practically zero
4. High dielectric and ample tensile strength
5. Remarkable resistance to flame, abrasion, chemicals, oils, greases
6. Flexible at very low temperatures
7. Uniformity of size and quality

May we send you samples and complete information?

ELMER SZANTAY, M.E. '35, GENERAL MANAGER

Sandee Manufacturing Company

3945 NORTH WESTERN AVENUE · CHICAGO, ILLINOIS

EXTRUDED PLASTICS AND SPECIAL TOOLS

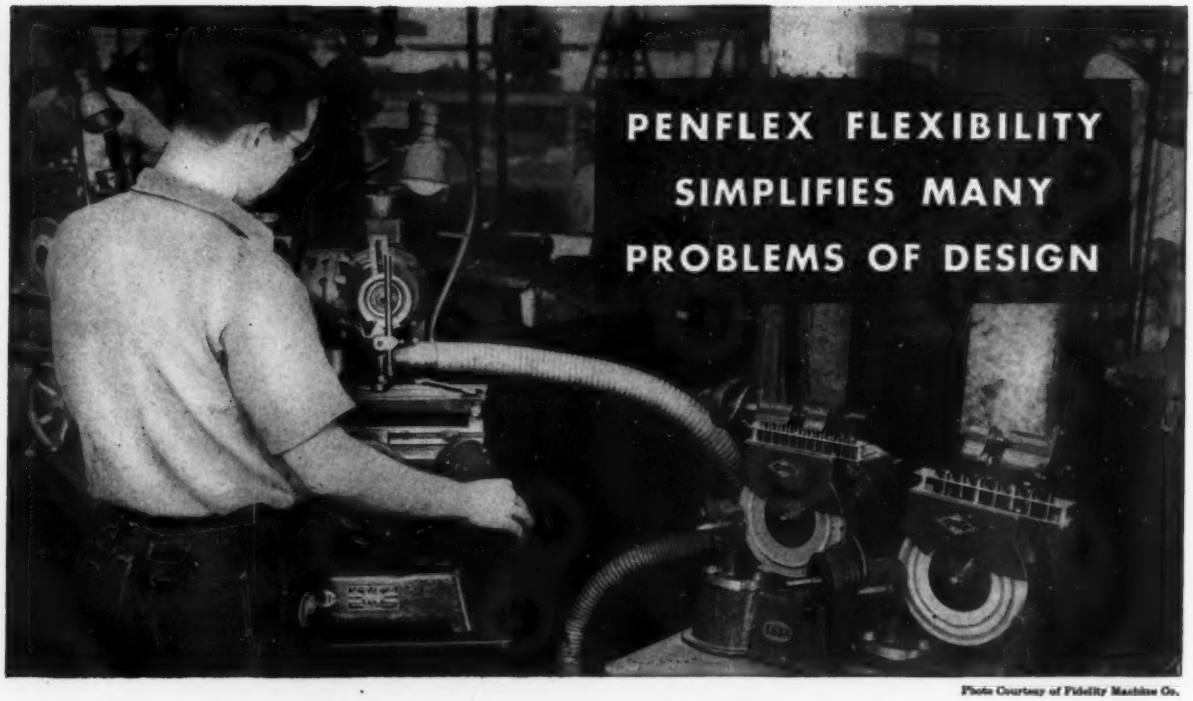


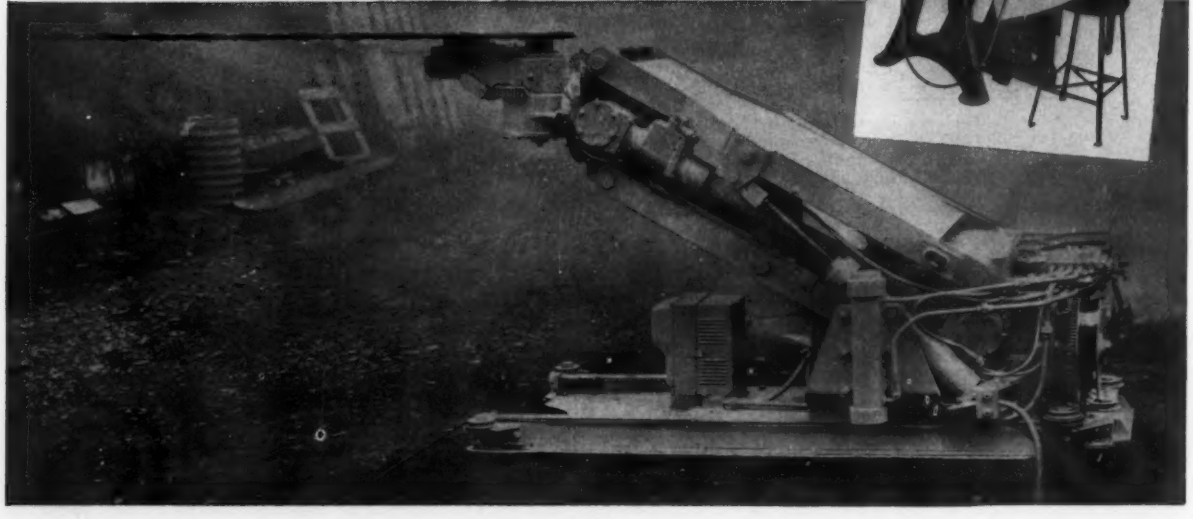
Photo Courtesy of Fidelity Machine Co.

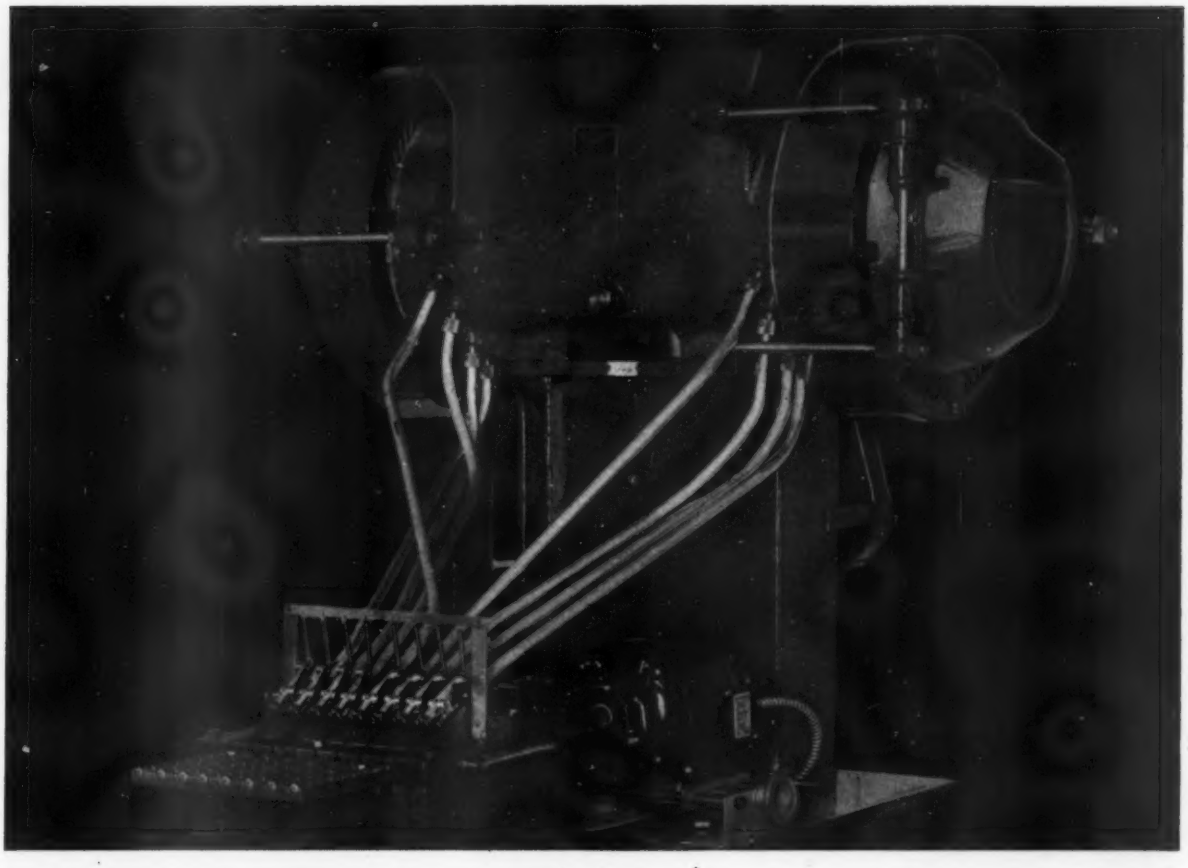
ILLUSTRATED are several applications of PENFLEX Flexible All-Metal Hose and Tubing, showing how PENFLEX simplifies design problems. Light in weight with flexibility to make inaccessible installations easy, PENFLEX All-Metal Hose and Tubing are suitable for mobile units, bilge ventilation, fume exhaust, dust collection, coolant conveying, hydraulic and air controls, vibration isolation, oil can and similar flexible spouting, armor for flexible shafting, conveying of dry granular materials, and many other applications in high or low pressures.

PENFLEX, tight as pipe but flexible, follows any desired path. Material flows through smooth, easy bends without sharp turns to clog.

Tell us what type of material you are handling, and the operating pressures. We will send you data sheets promptly.

PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.
7215 Powers Lane, Philadelphia, Pa.
ESTABLISHED 1902





Another FIDELITY Machine — war-born with peace-time applications — perhaps for you

If you have many small metal parts which have had to be sorted and handled manually—in large quantities—you will be interested in this adaptable basic machine which FIDELITY has made in a number of variations.

The parts are dumped into a hopper from which they are fed out in single or multiple tracks, in correct position for the next process. In some cases, sequential steps are taken care of by additional mechanisms or attachments, made integral with the automatic hopper and feeder element.

The machine illustrated sorts and delivers copper slugs through eight tracks at the rate of 20 slugs per minute per track—a total of 160 per minute.... Receiving trays, platforms or troughs in such machines can generally be designed to function also as piece counters or batch boxes.

The range of FIDELITY'S developments in special machines designed and built to solve unusual and special production problems is described briefly in "Facilities."

A copy of this book is available if you write on your business letterhead.

BUY MORE BONDS

ARMY E NAVY

33 YEARS' EXPERIENCE

Designers and Builders of Intricate, Automatic Precision Machines

FIDELITY MACHINE COMPANY

3908-18 FRANKFORD AVENUE, PHILADELPHIA 24, PA.

How can machine tools avenge this

Dunkerque in Arkansas?

This is no enemy propaganda. No "usually well-informed sources" or Berlin broadcasts tell this tale. This is real . . . this is here . . . and this is defeat.

Our own private *peacetime* Dunkerque — in Arkansas, in New York, in West Virginia or California — in countless American "homes" where millions of people are ill-housed, ill-clothed, and bodily and mentally ill-fed.

What part will machine tools play in turning this kind of defeat into victory? The *whole* part, if the men of industry have the vision and the freedom to plan ahead, and to carry out what they plan.

If you are a manufacturer, there is one thing you can do at once: Have your production men and planners consult now with the engineers of the leading basic machine tool producers. They can help you in planning today your part in the peace that must be won after the war is won.

One of these is a Bryant man. . . . We invite you to send for him.

BRYANT CHUCKING GRINDER COMPANY SPRINGFIELD VERMONT, U. S. A.

Bausch & Lomb Contour Measuring Projector

Today Precision *Must* Be Commonplace

American fighting men on our fighting fronts depend upon production line accuracy . . . for ten-thousandths of an inch variation on the production line can mean the difference between a hit or a miss on the battleline.

The Bausch & Lomb Contour Measuring Projector makes such accuracy possible on the fastest moving production lines, because it takes many vital inspection jobs "off the surface plate" and eliminates the tedious, time-consuming computations of the "sine bar." Inspections for accuracy become routine jobs.

Throwing an accurate, sharply defined shadow image of the object under examination on a translucent screen, the B&L Contour Projector permits exact measurements or comparison with an enlarged template drawing at magnifications great enough for easy and accurate dimensioning.

Here again is a Bausch & Lomb peacetime development that serves America at War. The B&L Contour Measuring Projector is helping speed production of fighting tools for our fighting men.

For Bausch & Lomb Instruments essential to Victory—priorities govern delivery schedules.

BAUSCH & LOMB

OPTICAL CO. • ROCHESTER, N.Y.

ESTABLISHED 1853

AN AMERICAN SCIENTIFIC INSTITUTION PRODUCING OPTICAL GLASS AND INSTRUMENTS FOR MILITARY USE, EDUCATION, RESEARCH, INDUSTRY AND EYESIGHT CORRECTION

No. 12 Plain Milling Machine just naturally helps favor cutters — it has . . .

Ample power — to pull the cut smoothly

Machine rigidity — for heavy loads without vibration

42 Speed changes — permitting best selection for cutter and work

28 Feed changes — Many may be used in dual-combination to reduce cutting time

B&S

Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

BROWN & SHARPE

BATH
IRON WORKS
CORPORATION

Shipbuilders and
Engineers

•

BATH, MAINE

THE TABULAR VIEW

Upshot. — This year witnesses success in a crucial race against time — the pitting of American ingenuity and industrial might against skyrocketing demands for rubber imposed by war. Reviewing the situation, BRADLEY DEWEY, rubber director for the War Production Board, emphasizes (page 195) the continuing need for conscientious conservation and considers some of the perplexing future questions which may be expected to grow out of our swift wartime creation of a major industry. A graduate of the Institute in 1909, Mr. Dewey served as colonel and chief of the gas defense division, Chemical Warfare Service, in the first World War, receiving the Distinguished Service Medal. He was recalled from the chemical industry to become deputy rubber director in September, 1942, becoming director in the fall of 1943.

Undaunted. — Science and technology are creations and creators of the free mind. Hence they have a special interest in all agencies working against oppression and authoritarianism. One such agency, of vital importance and growing strength in outraged Europe, is the underground press in occupied countries, described for The Review (page 197) by DOUGLAS C. MCMURTRIE, who, says *Bookbinding and Book Production*, "has probably done more than any other man to advance the field of knowledge in typography and printing." Member of the Technology Class of 1910, Mr. McMurtrie is director of typography for the Ludlow Typograph Company.

Program. — The lone word "housing" is too easy a dismissal for the manifold problems involved in the rehabilitation and reconstruction of American urban and rural regions. That it muffles difficulties and at the same time conceals a myriad opportunities for various groups in the community is plain in the program trenchantly stated (page 200) by WALTER R. MACCORNACK, Dean of the School of Architecture at Technology. After his graduation from the Institute in 1903, Dean MacCornack engaged in widely diversified architectural practice, with major emphasis on the design of schools and college buildings and on problems of housing. He returned to Technology as dean in 1939.

Anthracite. — A story of pioneering in the development of steam propulsion for ships is told in this Review (page 202) by W. MACK ANGAS, Captain, Civil Engineer Corps, United States Navy. The ingenious Perkins family, whose steam yacht *Anthracite* was center of much interest, find an able commentator in Captain Angas, who has been a Navy man since shortly after his graduation from the Institute in 1917, and a keen student of maritime affairs for as many years.

Arcs. — Author of the first daily Washington column ever syndicated to newspapers, FRED C. KELLY has been a newspaperman most of his life. He runs a 600-acre farm. He has a stock of anecdotes beyond parallel. He writes nowadays when and what he pleases. The Review presents (page 192) gleanings from his recollections of the days when gaslight still flared high but saw its doom approaching in the brilliant arc lamps which Charles Brush made commercially practical.

Information supplied by an Industrial Publication

There are two operational factors that have more to do with the life and efficiency of reamers than may be generally known. One is the matter of feeds and speeds; the other, the condition of the hole.

As to the former—with due regard to machine set-up, required finish, and part design—in general, reamer speeds should be from 60 to 70% of drilling speeds, and feeds should be two to three times faster.

The amount of stock left in the hole has considerable effect on reamer life. If there is insufficient stock, the reamer will tend to bind instead of cutting. This is also true with bell mouthed holes, caused by faulty drilling, or drilling without a guide bushing.

For efficient reaming in ferrous metals 1/64 inch of stock should be left on holes up to 1/2 inch diameter, and 1/32 inch left in holes of greater diameter. A smaller amount of stock may be left in softer metals. The correct amount in individual cases can be determined by experiment.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

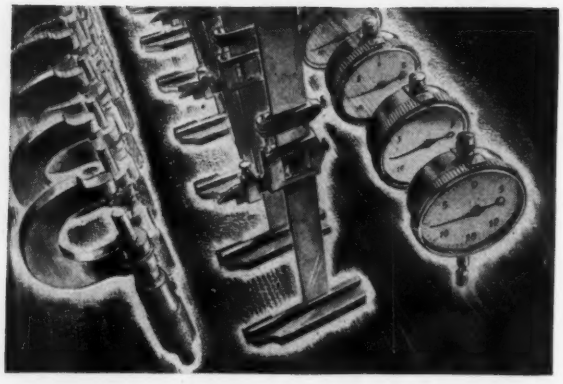
ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

500 Fifth Avenue · New York City

MOLY



All MADE TO STARRETT STANDARDS OF QUALITY AND ACCURACY, HOWEVER URGENT THE DEMAND

Starrett precision and Starrett workmanship have been steadfastly maintained despite the critical pressure for delivery of tools without which mass production of superior weapons and armament would never have been achieved.

The quality and accuracy of Starrett Tools will stand you in good stead whatever demands the future may make upon you.

THE L. S. STARRETT CO., Athol, Massachusetts, U. S. A.
WORLD'S GREATEST TOOLMAKERS

Now, with Service Star

STARRETT

PRECISION TOOLS • DIAL INDICATORS • GROUND FLAT STOCK
HACKSAWS • METAL CUTTING BANDSAWS • STEEL TAPES

All Of Us Pause

. . . to think, at times, of the Future, and what it may bring. Diefendorf, a pioneer in precision cut, special gears, stands ready to supply peacetime America with the same high quality gears that now help America at war.

DIEFENDORF GEAR CORPORATION
D. W. DIEFENDORF '30, *President*
SYRACUSE, NEW YORK

diefendorf
★★★★★ **GEARS**

MAIL RETURNS

Forwarded

FROM WILLIAM F. RIVERS, '26:

Let me congratulate you on the March, 1943, issue of The Review, which has recently reached me [August 13]. The article by Clarence D. Howe, '07, concerning the Canadian viewpoint on handling munitions and supply contracts is extremely interesting to me and to others out here. It may please you, and him, to know that I have forwarded the March issue to New Delhi, where it will be seen by several persons holding jobs out here not dissimilar to Howe's.
Bombay, India

Contrast

FROM ALFRED V. DE FOREST, '11:

I notice in the article by Herbert S. Swan on page 90 of The Review for December a statement: "To progress we must produce more units at less cost. Not to do so means that we are slipping either into a static or into a permanently lower standard of living." This seems to me to reflect the general attitude of many technical and semitechnical publications and would seem to indicate that if people have more gadgetry they will make more progress. This particular poisonous philosophy may not necessarily attack technical men more than others, but at least they should be sufficiently educated to be on their guard against such expressions.

In contrast to this attitude, I quote from an address by David Sarnoff before the Lancaster branch of the American Association for the Advancement of Science on November 11: "Science is a mighty ally of freedom — its advance has brought much release from drudgery and from want. However, we must progress still further. For better machines are not all that is needed to make a better life. We shall have a better world only to the extent that our social thinking and our social progress keep pace with the advance of physical science."

Under the pressure of war, science has assisted in increasing production many millionfold, but the emotions of war have blunted our social thinking and hindered our social progress far below the level attained by Benjamin Franklin and Thomas Jefferson.
M.I.T., Cambridge, Mass.

Salute

FROM WILBUR MORPHY:

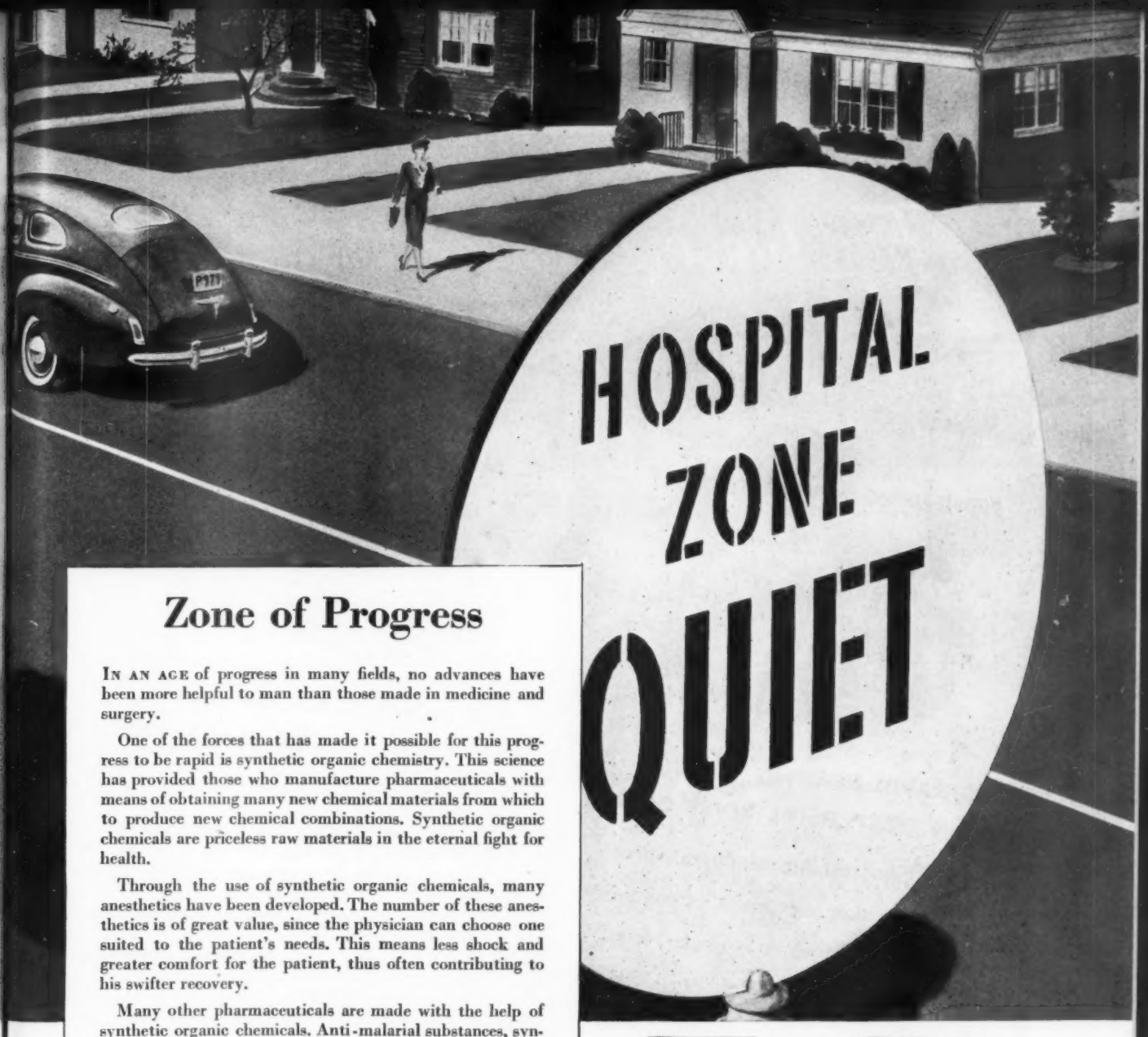
Very few of the numerous magazine articles these days discussing what aviation will be after the war can come up to S. Paul Johnston's in the January Review. It is a good hard-hitting job, and doesn't seem to be based on moonshine and wishful thinking. We need to have other rosy postwar pictures debunked in the same fashion.
Greenpoint, N. Y.

Speed with Economy

Chas. Pfizer & Co., Inc.

The ability to build *quickly* and *well* is not acquired overnight . . . When you engage us, you have an organization that has been geared for fast, closely-coordinated service ever since its formation — 26 years ago.

W. J. BARNEY CORPORATION
101 PARK AVENUE, NEW YORK
INDUSTRIAL CONSTRUCTION
Alfred T. Glassett, '20, Vice President



Zone of Progress

IN AN AGE of progress in many fields, no advances have been more helpful to man than those made in medicine and surgery.

One of the forces that has made it possible for this progress to be rapid is synthetic organic chemistry. This science has provided those who manufacture pharmaceuticals with means of obtaining many new chemical materials from which to produce new chemical combinations. Synthetic organic chemicals are priceless raw materials in the eternal fight for health.

Through the use of synthetic organic chemicals, many anesthetics have been developed. The number of these anesthetics is of great value, since the physician can choose one suited to the patient's needs. This means less shock and greater comfort for the patient, thus often contributing to his swifter recovery.

Many other pharmaceuticals are made with the help of synthetic organic chemicals. Anti-malarial substances, synthetic adrenalin, man-made vitamins, anti-pyretics (to cut down fever), many kinds of sedatives, vehicles in which drugs are administered, and solvents used in extracting drugs from natural sources are some of the medicinal aids made possible by these chemicals.

CARBIDE AND CARBON CHEMICALS CORPORATION, the Unit of UCC which pioneered in the field of synthetic organic chemistry, has made more than 160 synthetic organic chemicals available in commercial quantities. Many of these chemicals are important in various ways in the pharmaceutical industry.

Pharmaceutical manufacturers, and research and technical men in chemical and allied industries, are invited to send for a copy of the 100-page booklet **P-2,** *"Synthetic Organic Chemicals," which technically describes the properties and some of the uses of these chemicals in pharmaceutical and other fields.*

BUY UNITED STATES WAR BONDS AND STAMPS

SAVINGS FOR YOU! Synthetic chemicals in tank-car quantities serve as solvents and raw materials throughout industry to make more and better things at less cost to you.

COLD-PROOF! Coolant for liquid-cooled aircraft engines and base for anti-freeze in military cars and trucks is ethylene glycol, an important synthetic chemical.

MAGIC PLASTICS! Wonderful plastics that look like glass, stretch like rubber, and which are proof against water, sunlight, oils, and many chemicals are made from VINYLITE synthetic resins.

MAN-MADE All types of synthetic rubber require synthetic organic chemicals for their manufacture. Here's hope for tires for you in the future.

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC **New York 17, N. Y.**

Principal Units in the United States and their Products

ALLOYS AND METALS
Electro Metallurgical Company
Haynes Stellite Company
United States Vanadium Corporation

CHEMICALS
Carbide and Carbon Chemicals Corporation

ELECTRODES, CARBONS AND BATTERIES
National Carbon Company, Inc.

INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation

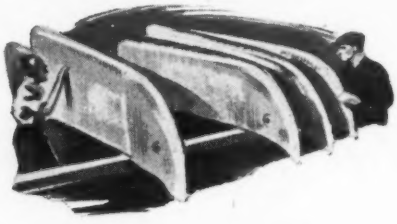
Trail Blazing in the Skies

PIONEERING NEW METHODS

THE RAPID-HEATING EXPLOSIVE RIVET GUN

is a new Goodyear Aircraft development that greatly simplifies and shortens the work of setting explosive-type rivets. Lighter and easier to handle, it can be used on surfaces heretofore inaccessible with other equipment, speeding up production.

BUILDING PROVEN AIRCRAFT



THE FAMOUS MARTIN B-26 MARAUDER

is equipped with major flight control surfaces, subassembled by Goodyear Aircraft. Since pioneer days Goodyear has been privileged to furnish Martin with many parts and accessories, and is one of its principal wartime suppliers.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRCRAFT INDUSTRY

1. *By constructing subassemblies to manufacturers' specifications.*
2. *By designing parts for all types of airplanes.*
3. *By re-engineering parts for mass production.*
4. *By extending our research facilities to aid the solution of any design or engineering problem.*
5. *By building complete airplanes and airships.*

BUY WAR BONDS to Speed Victory

GOODYEAR AIRCRAFT

William W. Lewis, '89

Spiral stair in the tower, Mission San José, San Antonio, Texas, founded in 1720. Each step is made of a single plank.

VOLUME 46 NUMBER 4

THE TECHNOLOGY REVIEW

TITLE REGISTERED U. S. PATENT OFFICE

EDITED

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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From a photograph by Shipvan from Black Star

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Relating to the Massachusetts Institute of Technology

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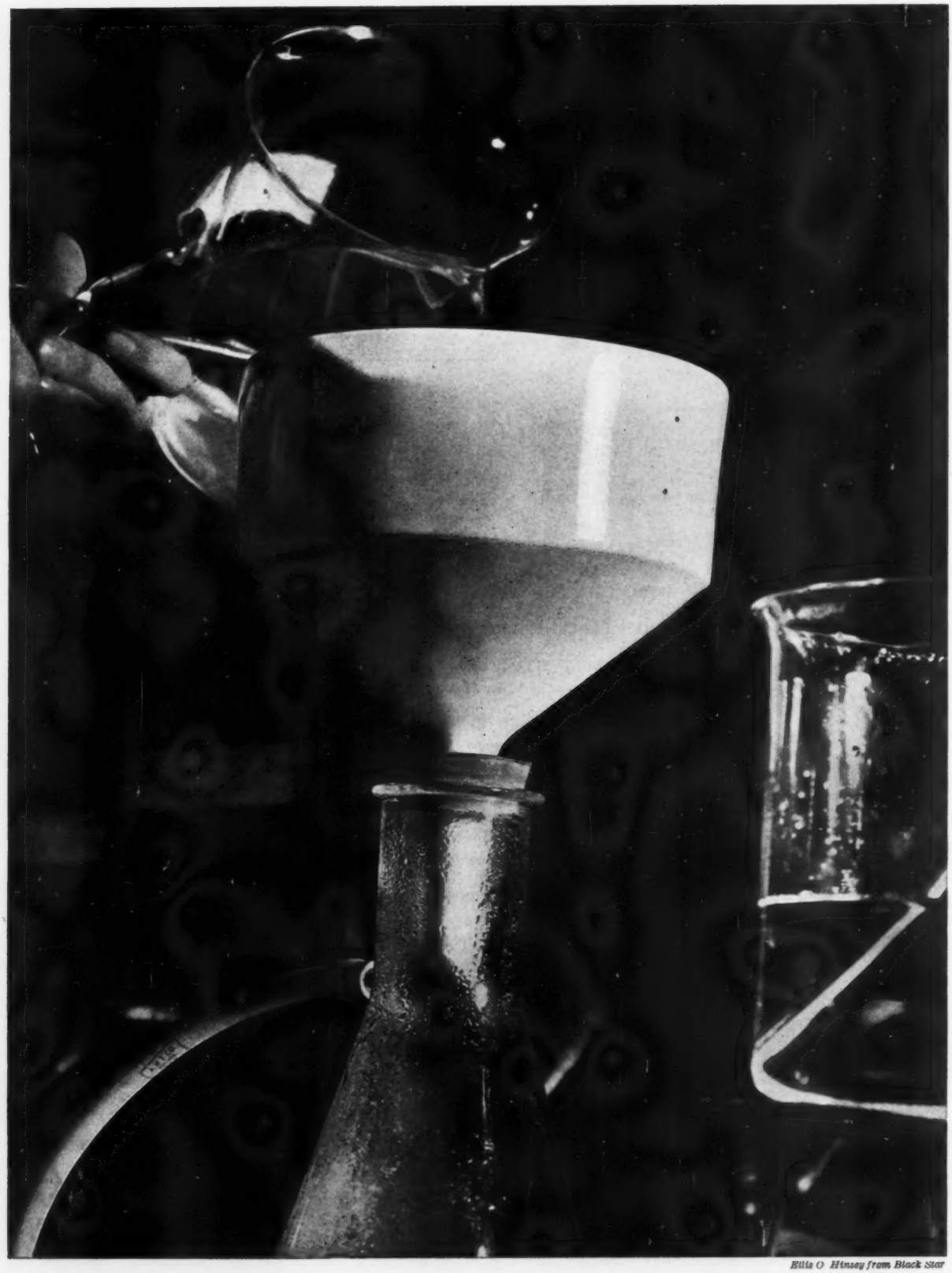


Ellis O Hinsey from Black Star

Porcelain Funnel

THE
TECHNOLOGY
REVIEW

Vol. 46, No. 4

February, 1944

The Trend of Affairs

Work to Be Done

HIGHER education, compressed, accelerated, and upset as it necessarily is during the war years, must expect to be in postwar years something considerably different from what it was a decade ago. It must become something nearer to what it then conceived itself to be, but was not. No thoughtful teacher or scholar denies this fact; on the contrary, the self-scrutiny which had begun to disturb the academic world before the war has increased in intensity, and possibly in promise of useful result, as the dislocations of war have broken down more and more of the sedative stockade of accepted and acceptable routine.

It is well that matters stand thus, for higher education very properly should look toward a more exacting and more critical responsibility in decades ahead. Reasons are obvious, some immediate and objective, others continuing and intangible. Once war has ended, a million or more men and women will return from battle fronts and bases to classrooms, lecture halls, and laboratories in the expectation of securing there some aid in the baffling task of re-establishing themselves in civilian life. Men of letters often enough in recent months have remarked forebodingly that these returning fighters, having lived intimately with "the bright-shining deadly machines" of war, having been impressed again and again with the sleek competency of those machines, will be impatient of anything but cold efficiency. Thus these observers draw none but gloomy conclusions for any other than materially utilitarian education, arguing that emphasis must center more and more on skill in the manipulation and exploitation of physical things, less and less on the ideas which implement appraisals whereby man evaluates himself and his world in the effort to define and to establish the good life.

This is a superficial reading of present events, and may well be scouted as not merely inaccurate but distinctly unjust. Even were it true, more distant and less sharply definable events are to come which would more than counterbalance it. We shall have, once this war is past, a society relying upon and complicated by technology and technological devices to a greater degree than we now can realize. The economic system under which that society will operate may very probably be radically altered through the influence of these devices and the shifts in commercial value, in concentrations of effort, in permanency of institutions, which they may be expected to induce. The thoughtful man, in contemplating these possibilities, does well to use as his criteria not the likelihood of mass effort to sell multifold streamline gadgets to millions of heedless consuming points in space, but the possibility of sweeping fundamental change in the functional organization of the economic state.

It has been held many times that the good life need take no thought of material things and operating systems developed about them. This transcendental view is interesting, but at least exotic. The good life is not lived in a vacuum, even by philosophers; it must be reached, if at all, in terms of the here and the now. The deep changes that can be foreseen for the decades after this war must therefore be reckoned with by teachers and scholars; it is these changes and their effect both on students who come from war fronts back to schools and on newer generations of students whose lives will be lived in economic and social regions now unmapped which are the incisive reason for self-scrutiny by colleges and universities.

If there is any justification for the gloomy prophecy that the ethical and humane are to be lost from the education of the future, it lies in the implicit admission that the general grasp of ideas essential to the good life has been palpably insufficient in the past. If we have been unable to assimilate pre-war science and technology into our economic and social structure, one argument runs, we have little chance of coping with what the future may confidently be expected to produce. Another version maintains that religion, philosophy, and the imponder-

ables these terms connote have demonstrated inability to fit a man to live happily and uprightly in our times, and that therefore they should be swept out with the rubbish and replaced by some scheme of ergs. Or, others hold, what need has man of intangible considerations, anyway, if he has baths, food, shelter, radio, auto, and so on? Given these latter, he will in time learn to be clean, well fed, warm, amused, and therefore content.

The central jeremiad out of which such arguments are projected is based on a group of assumptions, most of them false. Of the lot, those chiefly conspicuous for falsity are: Man is purely an animal. Science and engineering are fundamentally different from and antagonistic to all other spiritual and intellectual activity. The manufacture of implements, utensils, and glorified toys is the sole purpose, concern, interest, or reason for which science and engineering exist. Education has been given full opportunity and has made full use of the opportunity to explore, expand, and inculcate in men the virtue which is able to recognize and to seek the good life.

The last of these fallacies is rigorously examined in *Liberal Education*, which Mark Van Doren wrote at the behest of the Association of American Colleges. This is a powerful and an often disturbing book, which demands of its reader sincere study emulating the hard thinking which its author has done.

"The better kind [of education] I have endeavored to describe," says Mr. Van Doren in a prefatory colloquy, "is neither easy in itself nor simple to set forth. Education is not a simple subject, as I have discovered to my sorrow. So I have not disguised my presentiment that the task of liberal education is going to be at least as hard as the task of winning a total war. It is the task, for instance, of knowing what to do about science. But that will mean knowing science as even science does not know itself today. The liberal education currently lamented as a war casualty has not been distinguished by the possession of such knowledge. Its successor must be. And there are enough other things that it must be to justify, I think, the emphasis I have placed upon the need for universal discussion, starting tomorrow, of the ideal college curriculum. Day after tomorrow may be too late."

Some of Mr. Van Doren's conclusions will provoke strong dissent; his analysis of the situation of education cannot but evoke admiration. It is penetrating, it is temperate, and it is hardheaded. By it, he is brought back and brings his reader back inevitably and gratefully to the trivium and quadrivium of earlier learning, or to "language" and "mathematics," the inclusive division whereby the seven liberal arts become two great disciplines — the first distinguishing the kinds of things, the second handling their quantities. The muddled state of education as we know it arises in part because though the second group of studies preserves the precision which both groups once conspired to promote, the two groups no longer penetrate each other; in part because education has allowed the arts of the trivium — grammar, rhetoric, and logic — to degenerate; and in part because in the Seventeenth Century, "when the new science developed the quadrivium as an exclusive discipline . . . language (or literature) and mathematics (or science) became . . . enemies. . . ."

The essence of the problem, then, as Mr. Van Doren's analysis suggests, is to regenerate the arts of the trivium, restoring to them the intellectual rigor which is as much their birthright as it is that of the quadrivium, and to re-establish the right relation between the two great groups. What do these prescriptions mean? Answers to this question may be had on any level desired. One is implicit in the fact that a poet writing profoundly and ably about man in the *American Scholar* embeds the ancient fly of "different than" in the amber of his verse while a botanist in the same week argues in *Science* that descriptive words such as "abundant," "common," and "scarce" should be given agreed relative values in order to assure that publications shall be precisely comprehended.

Esso Oilways

A slag stream strikes a brilliant right angle . . .

. . . which glass, flame, and a craftsman's hands recapitulate.

Richard W. St. Clair, '50

The problem is of especial interest to such institutions as schools of science and technology. One of them, at least, in students, staff, and alumni, would take exception to Mr. Van Doren's statement that "the curriculum is not something which it is fashionable to ponder." To these institutions, the dilemma of liberal education is of perhaps greater concern than it is to any others. They are the wardens of the quadrivium, and must before all others see to it that the studies of the quadrivium are mature in the full sense. They must, too, seek to restore the right relation between quadrivium and trivium, and therefore it is of extreme importance to them that the trivium once more assume its full status intellectually. In a world where increased technologies will call for increased humane and ethical sense, these schools as sources of technological advance and as teachers of the men having chief responsibility for the advance and for the utilization of the advance in the lives of the people, must stake everything on strengthening the general concept of virtue to meet the added demands which will be placed upon it. They therefore must agree with Mr. Van Doren that the arts of the quadrivium, "following the arts of the trivium as they do . . . are subject to them as all other arts and studies are, and cannot afford to forget the fact." Aristotle held that the trivium is "concerned with such subjects as fall in a sense within the cognizance of all men. . . . We are all in a sense dialecticians and rhetoricians; for everybody essays up to a certain point the criticism and support of a thesis, defence and accusation." The revitalized and earnest study of the universals — essentially the prime reason of both trivium and quadrivium — is the center of the target.

The scientific and technological schools of the United States are anomalies in one way: Each is partly a college and therefore a center of liberal education; each is partly a center of specialized professional study and therefore a university. Their work during the past century has met the pragmatic test successfully; the dominance of America in a score of scientific, technological, and industrial fields is in itself evidence enough. Beyond it, in a principal segment of our people are qualities of thought and approach directly attributable to the rigor and the integrity of education in science. But these schools would be the first to declare the pragmatic test insufficient and to agree in the necessity for the thoroughgoing reassessments which Mr. Van Doren urges.

The result, for these schools, can take two forms. One will be a greater co-operation with liberal arts colleges, through, for instance, wider use of the plan whereby a student spends three undergraduate years in the college, and two in the scientific school. The optimist will characterize this as cool recognition of comparative advantages; the pessimist, as easy abnegation of responsibility. Another form which the result may take will be unswerving revaluation of present curricula, seeking reorientations of energy and reallocations of time in order to make the restored arts of the trivium an integral part of the student's better intellectual and spiritual life.

Here is work to be done. Doing it ill may bring a truce and a prolongation of specious placidity, but can end only in disaster. Doing it well will give to teachers the reassurance of knowing that rarer among their graduates will be the citizen of Mr. Van Doren's legend, "who wakes up at forty to find himself going through a routine the meaning of which he has never known, and the value of which he now may doubt."

Specifically

THE announcement that British and American engineers have developed a successful, high-speed, jet-propelled plane was greeted by the press, as it should have been, with a fanfare of comment. While not unexpected, and presaged by the flight of the Italian Caproni-Campini plane in 1940, the event is an engineering milestone. But in spite of the fact that a brief statement on the principle of operation was contained in the releases, many of the commentators lost their

bearings somewhere between rocket and jet propulsion. Even the New York *Times* carried an editorial titled, "The Rocket Plane Is Here." "Evidently," began the editorial, "the astronauts who dreamed of kicking themselves from the earth to Mars were not mad." They would have been had they considered using any such ship as the newly announced development which is now being tested by Allied airmen.

In a very real sense, all vehicles using propeller, jet, or rocket propulsion are driven by jets. All move forward because they throw backward a blast of air, gas, or what have you. Specifically, however, the jet-propelled planes referred to by the military authorities form their jet by taking in large quantities of air at or near the nose of the plane; compressing it with ducts, compressors, or both; heating the compressed air by burning fuel, which need not be of any particular octane rating; and finally expanding the heated air through a large nozzle, from which the gases issue with far greater speed than they had on entering the plane. The reaction to the ejection of the gases drives the plane ahead. Since the oxygen which burns the fuel comes from the entering air, the plane would be as helpless as a propeller-driven craft were it to leave the atmosphere.

A rocket ship, on the other hand, would carry its own oxygen supply and would indeed be sufficient unto itself even in interstellar space. Present fuels containing their own oxygen, while capable of furnishing large amounts of power for short periods of time, must be greatly improved in efficiency before they can drive planes for important distances. Perhaps some of the more pessimistic reactions had this form of drive in mind.

Catching Up

SO swift has been its development that for the airplane to be farther advanced than the airport at which it lands is not surprising. And as war has spread the aeronautic net over more and wilder parts of the earth, the discrepancy has for a time grown greater. Steel mats which are spread out on the ground for swift preparation of landing strips, and the use of soil cement for the same purpose are but two of the immediate answers to the military phase of the problem.

Another, possibly of greater civilian interest for the future, is the packaged airport — an assemblage including not only all power and electrical apparatus, radio equipment for communication between the airport and planes or between the airport and other airports, lighting equipment, and meteorological instruments, but also prefabricated buildings for administration, living quarters, hangars, and offices, complete with heating, plumbing, and sewage-disposal systems.

As described by the *Westinghouse Engineer*, the packaged airports are built in four sizes and are also designed for three sets of temperature conditions: polar, temperate, and tropical. Moisture, wind, ice loading, temperature variations, insects, and other climatic factors are reckoned with in the engineering of the special types in each of the four sizes. Twelve types of main terminal buildings, for instance, are available.

The largest of the four outfits is designed to equip a feeder airport located in a fair-sized town on a main airway. Next down the scale comes a feeder airport calculated for a smaller community, perhaps on a branch air line. Third is one suitable for use at isolated mines, ranches, or industrial developments. Fourth is essentially equipment for an emergency landing field, comprising the minimum essentials to care for a plane that has been forced down.

When Electric Lights Produced Myths

BY FRED C. KELLY

AFTER Charles F. Brush had invented the first practical electric-light apparatus — publicly demonstrated only a little more than 65 years ago — the revolutionary invention was received with almost the same unawareness of its importance that greeted the Wright brothers after their world-shaking achievement at Kitty Hawk a quarter of a century later. About all that anyone believed about electric lighting was something that wasn't so!

The first arc light and dynamo actually sold went early in 1878 to Nicholas Longworth, whose son was later speaker of the House of Representatives. It was exhibited from a balcony of the Longworth home on one of the principal residential streets of Cincinnati; and as it

Valuable today as a means of supplying cooling water to Akron industrial plants, the Ohio and Erie Canal still performs important work in the world though it long since outlived its usefulness as a means of transportation. From the variegated photographic record assembled by C. E. Patch, '02, here are, starting at the left, the lower gate of Lock 1, Lock 2 and the old dry dock, and the crumbling arch of the old power sluice which put canal water to work industrially. De Witt Clinton formally broke ground for the Ohio and Erie Canal on July 4, 1825, and two years later the waterway was completed, connecting Akron and Cleveland. So successful was it that in 1840 a canal was constructed connecting it with the Ohio River at Beaver, just below Pittsburgh. The undoing of the canals as arteries of trade was the coming of the railroads; the Cleveland and Mahoning Railroad secured a controlling interest in the Ohio and Pennsylvania Canal in 1854; by the mid-Seventies, that waterway was serving only to carry water to a millrace which had been built some decades earlier to supply power to local enterprises. The Ohio and Erie itself continued in operation later; even as recently as 1906 appropriations were made for repairs to it. During a flood in the next decade, some of its 41 locks and gates were dynamited, however, and as a canal the system was a dead thing. The water in the upper sections and the lakes which feed them continues an industrial asset.

was of 4,000 candle power, it attracted a large crowd. Brush, its inventor, had gone to Cincinnati from his home in Cleveland to show how the outfit should be operated, and he was purposely in the crowd to hear comments. Many were there of the type who, if they know nothing about a subject and find others who know nothing about it either, will promptly start to explain it. In describing the scene afterward, Brush told of one man whose talk had attracted a considerable audience. This man called attention to the part of the apparatus at the top of the lamp and said, "That is the can that holds the oil." Then, referring to the side rod, he added, "And that is the tube which conducts the oil from the can to the burner."

The idea that the electric light depended on oil persisted for a long time. And there were plenty of other myths.

When one of the earliest of the four-light machines was exhibited to a number of guests at the plant of a large manufacturing company in Cleveland, one man looked at the apparatus carefully for a long time and then asked the inventor, "How large is the hole in that little tube that the electricity flows through?"

One of the frequent arguments raised in all parts of the country against the new lighting was that it would ruin people's eyesight. Everyone stared directly at the brilliant arc and then complained that it was too dazzling.

"This will never do," people said. "After you look at it, everything else looks dark. We'll ruin our eyes."

To which Brush calmly retorted: "The same objection may be raised against using the sun for lighting purposes. If a man is determined to ruin his eyes by staring at too bright a light, why doesn't he stare in the same way at the sun?"

Perhaps the public had some excuse for such nonsense, for even well-known scientists had promoted foolish beliefs. As late as 1873, Deschanel's *Natural Philosophy*, a well-known textbook, said: "The light of the voltaic arc has a dazzling brilliancy, and attempts were . . . made to utilize it. The failures of these attempts were due not so much to its greater costliness in comparison with ordinary sources of illumination, as to the difficulty of using it effectively. Its brilliancy is painfully and even dangerously intense, being liable to injure the eyes and produce headaches."

People did stare at the brilliant arc light and the fact that they did so was used for a long time as an argument against electric lighting. One reason they stared was that they wondered where the light really came from. They thought there must be some trick to it. Surely the electricity, or the light, came from oil, but where was the oil supply?

When the first public street lighting in the United States — in the Public Square at Cleveland — was turned on in April, 1879, hundreds of people among those who flocked to the square carried colored glasses or smoked glass, as if to witness an eclipse of the sun. It was a gala night; but when everyone discovered that there was no blinding glare nor any harm to eyesight, disappointment was general.

The street-lighting idea soon spread to other cities. Broadway, New York, was first lighted from 14th to 26th streets, and a few weeks later this circuit was extended to 34th Street. Neither the new street lights nor Charles F. Brush was popular with corporations that sold gas, and they did all they could to discourage use of the new invention. They might have done more harm than they did if Brush had not quietly explained to them, in a convincing way he had, that they were wrong, even from a selfish point of view, in fighting electric lights.

"Electric lights will *increase* rather than decrease use of gas," he predicted. "People have been living in darkness so long that they have organized their lives on that basis. After seeing brilliantly lighted streets and stores, they'll want more light in their homes. As they use more gas for lighting, you can make gas cheaper and that will open up almost limitless industrial uses for gas."

Another early difficulty was that users of electric-light outfits could not be induced to let them alone. This was especially true when a lighting apparatus was sold to a city for street lighting. Some employee in charge, mechanically minded, would at first be curious and then would wish to "improve" the device. Nearly every workman thought he knew more about the mechanism than the inventor did. Complaining of a lamp that had not worked properly, one man said, "Why, I've had it all apart four times and still it doesn't work." Tinkering with the lamps threw them out of order, and then the inventor got the blame. No matter what the reason, if the lamps

didn't work and the news became widespread, the business would be wrecked. Brush knew he must make the mechanism as foolproof as possible. So he put it together without screws or bolts of any kind which could be taken out and lost. All necessary adjustments were made at the factory when the lamp was tested, and then the parts were riveted in a way to make further meddling impossible. They were not only riveted together but were assembled a little in the manner of a Chinese puzzle.

The high-tension dynamos for series lighting which came along later did not suffer so much from tinkering because, as Brush used to say, they were so powerful, so able to look out for themselves, that they discouraged familiarity.

Much trouble was caused by trivial accidents and the lack of trained men to install or operate lighting plants. Since commercial electricity was just starting, naturally few experts were available to whom Brush could delegate important work, and he himself used to go around straightening out trouble. Once he traveled 1,500 miles to take a common, double-pointed tack from the bottom of a dynamo where it had caused a short circuit. Occasionally damage appeared to have been done maliciously, possibly by someone who disliked the mechanism because he was unable to understand it.

Perhaps it was his experience with human beings in the early days of electric lighting that made Brush feel sure, all the rest of his life, that the human race needed improving. This may have been a chief reason why he created the Brush Foundation, to promote research looking to "the betterment of human stock, and toward the regulation of increase of population."

"Quick, Henry, the . . .!"

AMONG such sentimentalists as fathers and football fans, the process of metalizing, or spraying a coat of atomized metal onto some surface, is fairly familiar because of its having been used to give a sort of immortality to the wrinkled shoes of Junior's infancy or the battered pigskin of Siwash's state title. The values of the process as a means of engineering economy and industrial thrift, however, are much more in the news nowadays, as sprayed atomized metal is used for correction and repair to save machine parts from the scrap pile, to build up components which have been worn beyond permissible dimensional tolerances, to deposit material of desired physical characteristics on a less costly base material, or to deposit physically weak materials on base substances possessing greater strength. The first of these uses are especially of interest at present in so far as they help to meet difficulties arising from the shortage both of machine tools and of skilled labor.

Fed either as wire or as powder into a gunlike instrument designed for the purpose, the metal to be deposited is melted by a fuel gas such as propane or acetylene and, once molten, is atomized by a jet of compressed air. The jet carries the minute particles of atomized metal from the nozzle of the gun to the surface of deposit at such high velocity that the particles flatten out into infinitesimal flakes as they strike the surface. The work to be coated is rotated, or the gun is traversed over it, so that thorough coverage is effected. Thickness of the deposit of course depends on the number of rotations or traverses and can be built up as desired on properly prepared surfaces. The coating thus deposited consists of layer after layer of minute flakes overlying each other much as do the scales of a fish or the shingles of a roof, and held together by cohesive force.

Loom rolls, crankshafts, bearing journals, press rams, and similar parts which have become worn are salvaged by the application of metal coatings of appropriate properties. The metalizing process is also being used to deposit corrosion-resistant coatings as protection against the effects of chemicals and heat. Extension of the idea of atomizing materials for this kind of application is under way, organic coatings such as rubber and various resins being utilized experimentally.

One More for the Menu?

IT doesn't take much of an economist to realize that a beverage which succeeds in tantalizing the palate of a public with a high standard of living can become not merely a big but a huge business. Coffee, cocoa, and tea are the mainstays of dozens of tropical countries and normally are major elements in world trade. The United States, for example, imported 2,055,065,000 pounds of coffee in 1940. Were this country's coffee imports to cease, depressions ranging from the severe to the catastrophic would strike Brazil, Colombia, Guatemala, Venezuela, El Salvador, Nicaragua, and Costa Rica. England plays a somewhat similar role in relation to tea.

In maté (pronounced "mah'-tay"), Brazil, Argentina, and Paraguay have another candidate for the bottom lines of American and European menus. Maté is a tealike, caffeine-containing beverage made from the dried and ground leaves of a South American holly tree. Much of the crop, which must already be controlled to prevent overproduction, is from wild stands of these bushy evergreens, which at first glance resemble orange trees.

Some 12,000,000 South Americans, most of them in the three main producing countries and in Chile and Uruguay, consume almost 400,000,000 pounds of maté yearly. Imports into the United States, however, amounted to only 82,700 pounds in 1940 and were said to be about 2,000 tons last year. This latter figure is about equal to the consumption of tea in Great Britain during 1745 (incidentally, 80 per cent of that amount was smuggled in).

As the largest exporter of maté, Brazil is naturally interested in tapping the greatest potential markets for this and virtually any other luxury beverage — the relatively well-to-do populations of North America and north Europe. Europe has other things on its mind, but Generoso Ponce Filho, a director of the National Matte Institute of Brazil, is at present in this country for the purpose of initiating advertising campaigns and otherwise promoting the use of maté. The stated goal is a comparatively modest 20,000 tons a year. This is all very well, but in view of the manner in which coffee and cocoa have attained popularity, it would seem that Brazil is missing a bet in not putting Carmen Miranda on the committee.

Tesserae

ONE gram of radium from 370 tons of pitchblende is the reported production from the radium-bearing and silver ores mined at Echo Bay on the east side of Great Bear Lake in the Northwest (*Concluded on page 232*)

The Rubber Situation

Establishment of a New Major Industry to Win the War Means a New Productive Factor in the Years of Peace

By Bradley Dewey

SUBSTANTIAL completion of the program of construction of plants for the manufacture of synthetic rubber, which was a major result of the epochal report of the Baruch Committee in September, 1942, will have been attained in the first quarter of this year. It will be late summer before the low point of our stock pile of crude and synthetic rubber is reached. The occurrence of these two events so close together should make any thoughtful American pause a moment and ponder.

In the achievement of the synthetic rubber plant program, we are bringing into existence in a little over two years an entirely new chemical industry, which is valued at three-quarters of a billion dollars and which in peacetime would have taken at least 15 years to develop. In coming to the low point of our stock pile — a point which, for natural crude, is somewhat below the reserves which the Baruch Committee's report declared to be the irreducible minimum — we have both a new demonstration of the close interrelationships existing among the materials and processes of a technological civilization and a new incentive for the application of every ounce of effort and conservation to see us through 1944 until production from the newly completed plants and improved manufacturing technique begin little by little to help fill the gap.

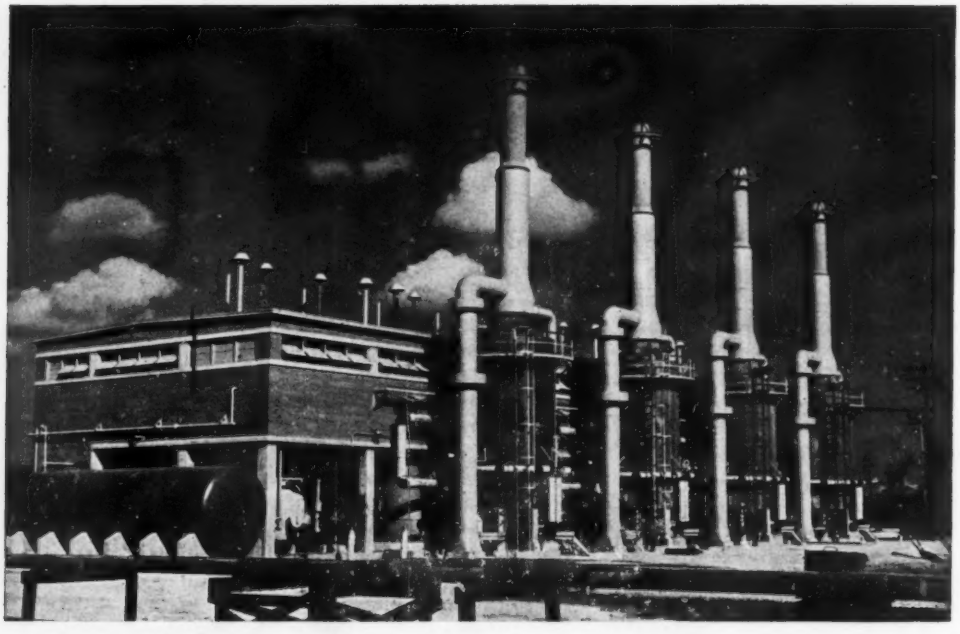
Controlled complexity — butadiene extraction plant of Standard Oil of Louisiana at Baton Rouge, showing a butadiene rerun tower

The decrease in crude rubber reserves, which full-scale production by the entire synthetic production setup should by degrees overcome, results in part from larger requirements of the armed forces for heavy-duty, combat, and airplane tires as a result of changing war conditions; in part from man-power shortages which made it difficult during the latter part of 1943 to man even existing equipment; in part from added demands imposed by the economies which circumstances enforced upon us a year ago. Add to these the fact that stocks of crude rubber, limited at best as a consequence of Pearl Harbor, have had to be tapped excessively for the construction of airplane tires and certain types of heavy truck and bus tires which cannot now be made satisfactorily of synthetic rubber except in conjunction with rayon tire cord. We have been and are short of rayon cord, and as long as we are, a greater degree of conversion to synthetics for these tires remains improbable.

What is the resultant of this situation? Simply this: (1) Our armed forces will have what they need. (2) Much of the civilian transportation burden for a long time yet to come must continue to be carried by recapped tires. (3) The rubber production program has successfully met the problem which had us worried in 1942: "Can enough rubber be produced before the crude rubber stock pile is exhausted?" (4) Since for a multitude of reasons, some of which will be discussed later in this paper, the strictest conservation will for a considerable time be an imperative necessity, the careful driver must continue conscientious co-operation and the careless driver must change his habits or stop driving.

Installations which have been brought into being during the past year and a half for the manufacture of synthetic rubbers and of their principal raw materials, butadiene and styrene, have a rated capacity of 850,000 long tons a year. This figure is 79 per cent of the capacity which Dr. Compton, Dr. Conant, and Mr. Baruch recommended in their report as the optimum for the United States and Canada. It is 50,000 tons more than 1941's consumption of rubber in the two countries, the highest on record. The imports of natural crude for 1943, totaling some 60,000 long tons, are expected to be increased by about 20,000 long tons this year. Hence in terms of past use of rubber, little trouble or skimping is to be foreseen.

But though there need not be trouble, there must be skimping, as far as anything but essential driving and other essential use of rubber is concerned. If we were living in time of peace, we should as a result of the amazing efforts of the country's chemical and engineering industry be very well off. But we are living in time of war, and



An ethyl-benzene dehydrogenation plant of the Dow Chemical Company at Velasco, Texas

ordinary expectations do not apply. Our needs are now far larger than they were in the 800,000-ton year of 1941, because of military requirements, because of depletion of inventories, and because of the necessity of helping our allies.

Military requirements are outside this discussion; it is enough to say that they will increase rather than lessen. So also with tonnages that must be supplied to others of the United Nations. What depletion of inventories means can readily be stated in terms of passenger car tires, however. Before December 7, 1941, about 55,000,000 new tires were distributed each year. In 1942, that figure was slashed to 4,700,000. In 1943, the total was 17,200,000. But these tires were the equivalent in service of but about 12,000,000, for they included war tires made of reclaimed rubber, used tires recovered from the collection made in 1942, and over 2,000,000 emergency tires serviceable for short distances. By the end of this year, the country will have been on a starvation diet for three years, so that the 30,000,000 tires which should be distributed during 1944 cannot be expected to relieve all difficulties. In this passenger car tire situation, then, is summarized one cogent reason why we shall continue to be confronted by necessity for strict thrift despite the phenomenally swift development of the synthetic rubber program.

Truck and bus tires present another problem. Overloading and, too often, higher than recommended speeds have taken a serious toll of these tires, so much so that new tires cannot be produced in sufficient quantity in the immediate future to prevent an extension of the present shortage. It is not the supply of synthetic rubber that will limit the making of large-sized tires, but the problems of conversion, the shortage of man power, the shortage of high-tenacity rayon cord, and the lack of adequate facilities in the industry, such facilities as mills, calenders, tire-building equipment, vulcanizers, and special large molds. The specific needs of our armed forces are very strongly felt in this field, for the principal increase in military requirements during the past six months has been for large tires for combat vehicles, landing craft, and airplanes. The manufacture of these not only requires substantially greater quantities of rubber, tire cords, and other components but has imposed on the industry the necessity of obtaining new production equipment and has accentuated the man-power problem.

As was to be expected, the Gargantuan new plants for the manufacture of synthetic rubber or its components have encountered varying degrees of difficulty in starting up. They are part of a new industry which, because of the urgencies of war, had to start from scratch. In general, there has not been time to test processes in pilot plants prior to construction, or to go through many other of the conventional preliminaries. The resourcefulness of the chemical and engineering industries of the nation, however, has been more than sufficient to overcome problems as they arose, and as fast as they arose. Consequently, synthetic rubbers in increasing quantities are being delivered to rubber manufacturers for conversion into rubber products.

As these new synthetic supplies became available to them, rubber manufacturers have been confronted by a problem of reconverting their plants for the production of the goods which they used to make and from which they had turned to the making of different products when Pearl Harbor cut off their regular flow of raw materials. Pre-war facilities and equipment which had been left in place during that change-over are now insufficient to meet the new demands. In addition, synthetic rubber thus far has required additional machinery and longer processing time than does crude rubber. The industry consequently set out on an expansion in plant and facilities calling for the investment of over seventy million dollars of its own capital. The majority of this expenditure will be for expansion of existing plants rather than for the construction of new plants.

Since recapping must carry the burden of transportation for some time to come, it is most fortunate that the reclaiming and recapping parts (*Continued on page 212*)

Printing Press *vs.* Tyranny

Underground Publications of Occupied Europe Strengthen Morale and Stiffen Resistance to the Nazis

By Douglas C. McMurtrie

THE printing press has, during more than 500 years since its invention, done much to further the cause of human liberty. But it has never performed a service more vitally important to the cause of freedom than it is rendering today in strengthening the morale of peoples in the occupied countries of Europe. In these nations, temporarily under German domination, patriots with fervor and determination seldom equaled are publishing hundreds of underground newspapers, in flagrant defiance of the Nazis' usually efficient Gestapo. This flame is one the Germans have proved powerless to extinguish.

So a free press still exists in Europe, though maintained at great human cost.

With newspapers here screaming such headlines as "Berlin Afire After Biggest Raid," "Reds Gain in Drive," and "Allies Smash German Lines," it is little wonder that almost no notice is taken of the steady, unrelenting fight against the Nazis on the publishing front. Except for brief items occasionally used as filler, the heroic drama being staged by the underground press of the occupied countries is a more or less silent episode in the struggle for victory and freedom.

The secret press should not be underestimated. While its exact accomplishments are difficult to appraise, it is certainly the principal force in maintaining the spirit of the conquered peoples and in stiffening resistance to the enemy. What it has done toward organizing effective sabotage and revolt is already known in many instances. Its work in co-ordinating active aid and in preparing the ground for invasion day will be better known in time to come.

It is easy to understand why the activities and inner workings of the underground press have been so meagerly publicized. Secrecy is of the essence of its operation, and general knowledge of its who's, why's, and how's would result in wholesale executions and would handicap an already perilous undertaking to the point where continued operation would be almost impossible. Hence the personal sagas of these unsung heroes will have to wait until the war's end before they can be told.

In the meantime, a not inconsiderable store of general information on the subject can be revealed. Of major interest is the number of clandestine newspapers which flourish under the nose of the Gestapo. Taken in the aggregate, somewhere near a thousand publications — ranging from mimeographed sheets and circulars to full-fledged printed newspapers — are distributed in the occupied lands. Leading the field numerically are France, Poland, and Belgium, each of which has between one and two hundred regularly published papers and newssheets. This number scales down through Norway, Czechoslovakia, Yugoslavia, Holland, Greece, Denmark, and little Luxemburg, the last of which has at least three known clandestine newspapers. Even the Axis satellites have their dissenting factions which give vent to their sentiments through secret publications, and Germany itself harbors some antinazi groups with their respective organs. Taking them as a whole, and taking even some of the publications individually, one is amazed that so much printing equipment and paper has been acquired under the alert nazi eye. If all issues of the secret publications that have been printed since the New Order began its program of social and economic enlightenment were laid end to end, they would supply the Austrian paper hanger with enough material to keep him busy throughout eternity.

Credit for being the first underground newspaper to make its appearance in defiance of the Nazis is due the Czechoslovakian *V Boj*. This was the organ of Josef Skalda, who, after an extended period of successful operation during which he welded the Czechs into a potent unit of resistance, finally was captured by the Gestapo in the basement of a warehouse where the paper was

LA LIBRE BELGIQUE

BILAN DE FIN D'ANNÉE

L'ORGANISATEUR

Belgian Information Office

Best known of all underground newspapers is* La Libre Belgique. *Published throughout World War I, it is now appearing in a second incarnation. Peter Pan is named as editor; the office of publication is stated to be in the building which serves as headquarters for the German occupation authorities.

United Nations Information Office

A group of French underground newspapers which proclaim eloquently that in France the spirit of freedom is not yet dead. Shown prominently is the pioneer yet short-lived Valmy. *The names of others are appropriate:* Humanité, La Voix de Paris, L'Ordre Nouveau, Liberté, Peuple de France!, Pantagruel.

being produced. After undergoing German torture and abuse in prison for some eight months, he was finally executed and today his memory is revered by Czech people, who have made him a national hero.

The French paper *Combat* leads the clandestine field with a circulation which in 1943 was estimated at 220,000 copies, divided among three editions and issued monthly. One edition is for the whole of France; a special edition is printed for the Lyon district; and the third, numbering about 40,000 copies, is for circulation in North Africa. Another French paper, *Libération*, is credited with 180,000 copies an issue. One is a weekly edition, published in the occupied zone, and the other is a biweekly affair distributed in the Vichy territory. Two others, *Le Populaire* and *Le Franc-Tireur*, boast circulations of 30,000 and 15,000 respectively.

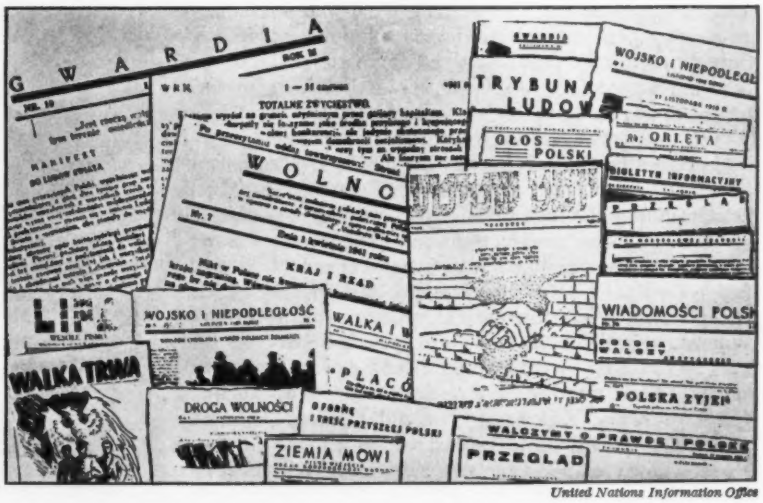
The clandestine press of Holland is led by *Het Parool*, *De Oranjekrant*, and *Vrij Nederland*. Each has a circulation estimated at between 10,000 and 20,000 and readership which is reckoned as more than 100,000.

Belgium's famed *La Libre Belgique* of World War I has reappeared in the present conflict and prints an estimated 40,000 copies in three editions — one in Brussels, one in Liége, and one in Namur. It was the publishers of this paper who in the first World War managed to have a copy of each issue placed on the desk of the German governor general of occupied Belgium. And at that time no amount of German supersleuthing discovered how the paper made its mysterious and regular appearance. Not until after the War was the fact revealed that the aged charwoman who cleaned his quarters was the culprit who placed it there. Today the No. 1 copy of each issue of *La Libre Belgique* is reserved for the governor general and is delivered to him, not so impudently but just as effectively, through the mails. Coincidentally, the present governor general, Baron Alexander von Falkenhausen, is a nephew of the Baron Ludwig von Falkenhausen who filled the same post in World War I. Also, Paul Jourdain, a son of the Victor Jourdain who was the mentor of the first *La Libre Belgique*, is understood to be connected with the current publication. Thus the enmity of both parties is of a personal as well as a national nature.

With torture and death the common occurrences they have become in the nazi scheme of things, such an end has almost come to be expected as penalty for defying the Germans. The operators of underground newspapers are given priority on this black list, and to them belongs the dubious honor of being the most sought after by the Gestapo.

Poland has perhaps borne the brunt of nazi cruelty and there, according to reports, persons associated with the secret press have been subjected to the most merciless treatment. Hundreds have been summarily executed for the crime of being "suspected" of underground activity, after having undergone agonizing tortures in attempts to make them confess their guilt and divulge the names of their associates.

The Polish information service reports an instance in which the staff of a secret paper, including some women, were surrounded in a house and ordered to surrender. Knowing their certain fate, they refused. They barricaded the doors and windows and prepared to make a fight-to-



United Nations Information Office

Underground newspapers published by fierce patriots flourish in conquered Poland. Here shown is a group of clandestine Polish papers. At the left is Lipa, *exclusively a humorous paper poking fun at Hitler, Goering,* et al., *at the risk of its editors' lives.*

the-finish stand. They did. For a while they traded shots with the Nazis, who soon tired of warfare on such an equitable basis and tossed a few grenades into the building. They then crept up and set fire to the house, cremating all the devoted members of the underground paper's staff who were inside it.

On another occasion, the anniversary of Hitler's assumption of power, says the Polish agency, the German commander at a prison in Poznań staged a celebration in honor of the event. The highlight of the entertainment program was a "hunt in honor of the Fuehrer." This unique example of nazi sadism consisted of turning a number of prisoners, including some secret-press workers, out of their cells and ordering them to run up and down the corridors while the drunken Nazis shot at them. Nine prisoners were killed in the "hunt," and several who were wounded were given the *coup de grâce* after the revelers turned to other amusements.

While these are isolated incidents and probably represent the peak of nazi brutalities that have come to light, in no place have the Nazis been known to look tolerantly on underground press activity, with the possible exception of Denmark. In general, the long prison terms, the tortures, and the executions of Poland can be matched in France, Belgium, Norway, Czechoslovakia, and the other subjugated nations. Although connection with the secret press carries with it such great risk, there is no lack of volunteers to fill the ranks as they become depleted through captures.

It should be noted that Denmark, at least until the widespread revolts and sabotage there several months ago, was the fair-haired child in the Nazis' adopted family. It was selected as a model of what could be done under the New Order; so the Danes enjoyed the rare privilege of being permitted to call their souls their own and partake of other German munificence. In contrast to the other occupied countries, they were permitted comparative freedom of the press; news was subject to less suppression, and the few underground papers confined their columns more or less to exposing quislings and listing the names of Danish girls who were consorting with German soldiers. When caught, the clandestine newspapermen were usually punished with prison terms ranging from 30 days to two years, depending on the magnitude of their paper's offenses. The Danes' actions indicated, however, that they found the abundant life under the nazi plan so short of abundance that they preferred to live in their old, humdrum, unenlightened style.

Δ Ο Ξ Α

ΕΚΔΙΔΕΤΑΙ ΑΠΟ ΤΗΝ ΠΑΝΕΛΛΗΝΙΟ ΕΝΩΣΙ ΑΓΩΝΙΖΟΜΕΝΩΝ ΝΕΩΝ

Αριθ. φύλλου 2 — Αθήναι Απρίλιος 1942

27 ΑΠΡΙΛΙΟΥ 1941 - 27 ΑΠΡΙΛΙΟΥ 1942

ΑΠΕΥΘΥΝΟΜΑΙΤΕ ΠΡΟΣ ΣΑΣ ΚΥΡΙΟΙ...

United Nations Information Office

The title of this Greek underground paper translates as Glory, *which is what the Greeks are once again contending for, with a daily share accruing to their heroic editors and printers. This and other Greek papers are printed from type.*

Paul Simon's escape to England and his subsequent report of the many difficulties and obstacles encountered in publishing the French secret paper *Valmy*, have given to that newspaper a large share of the clandestine press limelight. The story of how Simon and three others began publication of *Valmy* — one of the first secret-press efforts in France — with a child's toy printing press, and how they later developed the venture into one of France's most important resistance organs is familiar to many. The experiences of *Valmy*, (*Continued on page 216*)

United Nations Information Office

In small yet heroic Norway, underground editors have faced difficulties which many others would have considered insuperable. But the flame of Norwegian patriotism cannot easily be quenched. The publication showing the coat of arms is simply entitled We Love Our Land. *The others are named* Freedom, Home Front, *and* Forward.

America's New Frontier

Concerted Effort Is Essential for the Successful Solution of Problems of Replanning and Reconstruction

By Walter R. MacCornack

OUR American cities are headed toward bankruptcy. Indeed some of them are bankrupt already, and continue in existence only because they have the power to levy higher and higher taxes and thus are able to keep going on an unsound economic basis. We have seen them decline to this sorry condition within the last quarter century because of lack of interest, lack of understanding, and lack of united effort to prevent their decay.

Though we have boasted that our standard of living is the highest in the world, the fact is that a mere decade ago we had almost fifteen million people unemployed, one-third of our population living in homes unfit for human habitation, and more than one-half of our population earning incomes too low to provide decent shelter at the then prevailing cost of producing that shelter.

We are inclined, and rightly so, to speak with pride of the high level of civilization which exists in our country. But what can we say of that civilization when the cost of crime is reckoned at a billion dollars a month — a rate which in a quarter century would pile up a sum equaling the total cost of the present World War?

These gloomy statements are not made simply for the sake of gloom. They are made because they are important, because they are closely related aspects of a single problem, and because the solution of that problem will call upon traditionally American characteristics. That the problem must be solved if we are to see continued the kind of life for which this war is being fought, there can be no doubt. And working out a proper solution to it can be counted on for material assistance in bridging the perilous gap between war and peace.

We have come to the end of the type of physical development that faced the founders of our country — the mastering of a continent, or, as the phrase runs, the conquest of the frontier. But though the vast areas of the continent have been made useful for human existence, though our natural resources have been skillfully developed, we still face a frontier, and one that will call upon the very qualities of pioneering and individual effort which were essential in that earlier frontier struggle. The problem of so rehabilitating and repatterning social and economic endeavor in this country as to assure every able citizen the right to work at a living wage once the abnormal conditions of wartime production are gone is America's new frontier. Central to this problem is that of the city and of the individual family dwelling.

The replanning and reconstruction of our urban and rural communities are the form which this central portion of the problem takes. Replanning and reconstruction as they are intended here are no short-time program but one extending over a long period of years, one as exacting and detailed as the program recently outlined by the London Regional Reconstruction Committee in its report on the proposal to rebuild the city of London. The work which might be done and should be done in America finds occasion and necessity not in the immediate devastation of war but in the disastrous potentialities of latent decay. Thus lacking the urgent incentive of visible destruction, it is more easily postponed or ignored. In this fact is a cogent reason for early and vigorous action.

A united industry organized nationally, state by state and city by city, is essential for the accomplishment of a concerted program of replanning and reconstruction. Such an organization would have two purposes: the first, to create an intelligent, informed public opinion; the second, to secure action. For greatest effectiveness, it should be distinctly a private-industry venture, co-operating with such government agencies as can be judged necessary to the welfare of the nation. Six groups should be linked in organization for this program:

First, the planning group, including architects, city and regional planners, engineers, planning officials, highway officials, and private research groups.

Second, the producers and manufacturers of materials, comprising the Producers' Council, the National Association of Manufacturers, the American Road Builders' Association; the organizations maintained by the contracting industry and by the steel, lumber, concrete, automotive, and airplane industries; the public utilities, such as gas, electric, and telephone companies; and transportation services of all kinds.

Third, labor, including the American Federation of Labor and the Congress of Industrial Organizations.

Fourth, finance, comprising the American Bankers Association, the Mortgage Bankers Association of America, the United States Savings and Loan League, the National Association of Mutual Savings Banks, and the insurance companies.

Fifth, public health and education, including the American Medical Association, the American Public Health Association, the National Recreation Association, the American Hospital Association, schools, colleges, universities, and technical institutions.

Sixth, ownership and the public, comprising Chambers of Commerce, the American Bar Association, real estate organizations, building owners and managers, apartment house owners, private investors, neighborhood associations, women's clubs, tax associations, and foundations.

An organization consisting of representatives of these six groups and motivated by conviction of the importance of a broad approach to replanning and rebuilding, both as a correction of past evils and as a guarantee of future stability, can accomplish great things. The program to which such an organization should address itself is not one for professional architects and city planners only; it is one for the whole public. Important among the elements which must be considered in any project for postwar reconstruction, and which consequently are funda-

mental to the sort of program envisioned here, are those outlined in what follows. They are the factors on and with which the desired organization would work.

1. *Full Employment.* For the first time in the history of America, the problem of full employment is receiving nation-wide attention. It is of course fundamental to any proposal for widespread, co-ordinated replanning and rebuilding of cities and rural regions, for it is both a necessary initiating condition and a sure result of such effort. Actively at work on it, among other organizations, is the Committee for Economic Development under the chairmanship of Paul G. Hoffman, President of the Studebaker Corporation. Through studies of individual manufacturing plants, this committee is surveying the nation to find out the possibilities of increasing production after the war and of giving full-time employment to all. Examination of several of these reports indicates the very strong possibility that industry will be able not merely to maintain the present level of employment but to increase it. The relationship between incentive and production is being stressed by such men as C. E. Wilson of the General Electric Company, executive vice-chairman of the War Production Board, and James F. Lincoln of the Lincoln Electric Company. Another effort of the same kind is the National Planning Association, which consists of 14 leaders of industry, 14 of labor, and 14 of agriculture, under the chairmanship of William L. Batt, President of S.K.F. Industries and vice-chairman (international supply) of the War Production Board. One of the basic principles of the program of this group declares "that large-scale unemployment must not again stalk the land, that if masses of workers are idle or people are faced with starvation, the war will have been fought in vain."

2. *Money and Credit.* As part of its constitutional duty of maintaining the monetary system, Congress has from time to time exerted varied degrees of control over banking and credit. But there is still no method of co-ordination for the volume of long-term credit. For financing its expansion, therefore, the building industry has been dependent upon the fluctuation of the volume of savings and investment, which does not appear to be directly related to the progressive needs of capital and investment. Credit and the requirements of production must be synchronized.

3. *Methods of Finance and Amortization.* The experience of years has shown that the earning power of real estate will not support the load of high interest charges which has been placed upon it. Better investment policy, it is to be hoped, will lead to progressively lower rates of interest with the opportunity of utilizing a larger proportion of the financing charges as amortization to speed the reduction of the loan.

4. *Taxation and Service Costs.* The tax on real estate, which is primarily a local matter, yields virtually all the revenue out of which local government defrays the cost of services rendered to the community. Since considerable evidence indicates a tendency toward the investor's loss of home, business, or farm through foreclosure because of this more or less single tax on real property without recourse to other sources of income, a restudy of the entire tax structure is a vital problem.

5. *Revision of Tax Assessment Methods.* The tax spenders and the tax collectors are a part of the same political organization. Control of the ways and means of levying taxes on real estate is therefore largely in the hands of the spenders and often is based on political expediency. Consideration should be given to the creation of tax authorities free from political influence, whose duties shall be to devise tax methods on sound scientific and economic bases.

6. *Relation of City Planning to Regional Planning.* America has been very backward in organizing proper planning agencies. Too often they have been under the control of political administrations. Since theirs is a highly technical field, planning agencies should be separated from politics. Another evi- (*Continued on page 221*)

The balconies of an apartment house in Copenhagen offer interesting perspective.

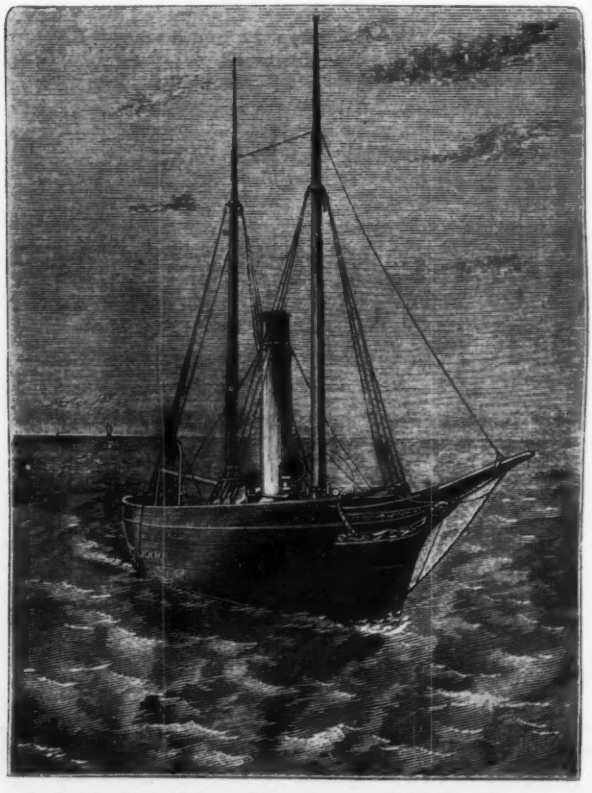
Benjamin W. Irvin, Jr., '38

High-Pressure Salesmen

The Pioneer Efforts of Jacob Perkins and His Successors to Improve the Efficiency of Steam Power Plants

By W. Mack Angas

MANY of the methods, processes, and devices of modern science and industry were unsuccessful when prematurely tried and promoted by pioneers to whom the techniques and materials of today were unavailable. Instances of such premature attempts to promote fundamentally sound ideas are found on many pages of the history of science and engineering. Brunel's construction of the *Great Eastern* in the 1850's and the campaign of Semmelweiss to introduce antiseptics may be cited as examples of the efforts of individual pioneers who were perhaps a generation ahead of their times. Other inventors have been even further ahead of the technological developments which would later make their ideas practicable. Jacob Perkins was such a man. Over 100 years ago he attempted to improve the efficiency of the steam power plant by utilizing pressures that even today would be called extremely high, and so sure was he of the fundamental soundness of his proposal that he devoted much of the energy of a busy, long, and otherwise successful life to the promotion of the "Perkins system" of using steam at high pressures. Years before the death of Jacob Perkins, his son, Angier M. Perkins, took up the task of promoting the utilization of steam at the pressures and temperatures which had been advocated by his father.



Anthracite, *one of the smallest steamers, if not the smallest, to cross the Atlantic. Of 70 gross tons, she created great interest in engineering and yachting circles because of the demonstrated economy of the high-pressure "Perkins system" power plant with which she was equipped.*

He succeeded in developing a practical application of extremely high-pressure steam to the heating of bakers' ovens, but he does not appear personally to have made any very serious attempt to utilize extremely high-pressure steam for the development of power, though in his later years he collaborated with his son, Loftus Perkins, in such work. Loftus Perkins, following the family tradition, carried out extensive research into the utilization of high-pressure steam in engines. By moderating the extreme pressures advocated by his grandfather to a mere 500, later 400, pounds a square inch, he built several small stationary and marine power plants which were at least partially successful. Even he was at least a generation ahead of his time, and with his death in 1891, the "high-pressure Perkins family" gave up its attempts to vindicate the soundness of Jacob Perkins' idea for the improvement of the efficiency of the steam power plant. Though the Perkins system of high-pressure steam plants was never accepted as practical, the engineering world is undoubtedly indebted to the pioneers of high pressure who promoted it and by so doing demonstrated that high-pressure steam plants were not inherently dangerous.

Jacob Perkins was born in Newburyport, Mass., on July 9, 1766. Little is known of his early life other than that his schooling was meager and that at the age of 13 he was apprenticed to a Newburyport goldsmith. When young Perkins was but 15 years old, his master died, and for a time he carried on the business. While still a boy he invented a method of plating shoe buckles which proved practical and profitable, and at the age of 21 he was employed by the Commonwealth of Massachusetts to make dies for copper coinage. At the age of 24, he invented a machine for cutting and heading nails at one operation, and later he became interested in engraving and invented a method for utilizing steel plates in lieu of copper plates. From Newburyport, Perkins moved to Boston and then to Philadelphia, and in 1818 he went to England with an associate and several workmen and there obtained a contract for supplying the Bank of Ireland with steel plates for engraving bank notes. While in England, he originated a process of transferring engravings from one steel plate to another by pressure, and he made to the art of printing and engraving other contributions which were widely used in such highly diversified fields as the engraving of postage stamps and the printing of textiles.

Perkins' inventions in the field of engraving and printing were undoubtedly profitable and enabled him to initiate and carry on experiments with high-pressure steam. Unquestionably he considered this work to be his most important contribution to the development of science and industry.

In 1823, when Jacob Perkins began serious experiments with steam at high pressures, the steam engine had become fairly common, but it was an extremely wasteful machine, utilizing steam at pressures which rarely exceeded 10 or 15 pounds a square inch, though Oliver Evans of Philadelphia was advocating and using boiler pressures as high as 75 pounds a square inch, and similar pressures were coming into use on the steamboats of our western rivers. At about this time, Sadi Carnot published his monumental *Réflexions sur la puissance motrice du feu et sur les machines propres à développer cette puissance*, in which he showed that the efficiency of a heat engine depended, other things being equal, upon the temperature range through which the machine worked. It is doubtful, however, that Carnot's mathematical researches into the theory of the heat engine were known to Perkins, who was probably led to advocate the use of high steam pressures merely by the fact that he realized that such pressures would permit the use of steam expansively to a far greater extent than would be possible with steam at the low pressures then popularly used.

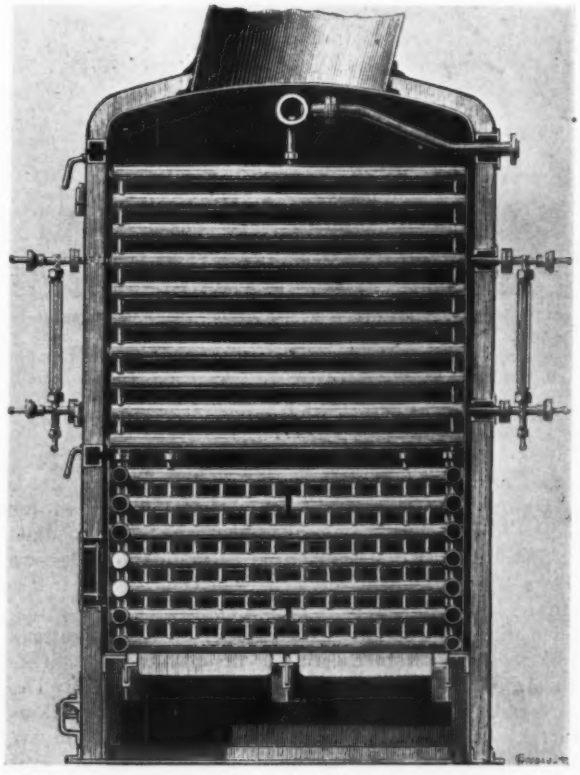
At all events, Jacob Perkins in 1823 built an experimental steam power plant consisting of a copper boiler, the capacity of which was about one cubic foot and the sides about three inches thick. The steam from this boiler, the safety valve of which was loaded to 550 pounds a square inch, was used in a double-acting, 10-horsepower engine of 2-inch bore and 12-inch stroke. Perkins found, however, that with steam pressures exceeding 200 pounds a square inch he had great difficulty with the charring of packing and the burning of lubricants. To overcome these difficulties he developed an alloy which required no lubricant, and using this material he built a single-acting engine which utilized steam at 800 pounds a square inch. The engine was condensing, but no attempt was made to develop a vacuum in the condenser, which was used merely to furnish distilled water for boiler feed. The valve gear of this engine cut off at $\frac{1}{8}$ stroke.

Encouraged by the results obtained with this engine, Perkins in 1827 built a compound engine using steam at 1,400 pounds a square inch. In the same year he proposed the construction of a marine engine using steam at 2,000 pounds a square inch in single-acting cylinders of 6-inch bore and 20-inch stroke to be fitted with valve gear cutting off at $\frac{1}{16}$ stroke. The condensation losses in such cylinders would have been enormous, and if the machine had been built it would undoubtedly have been a failure.

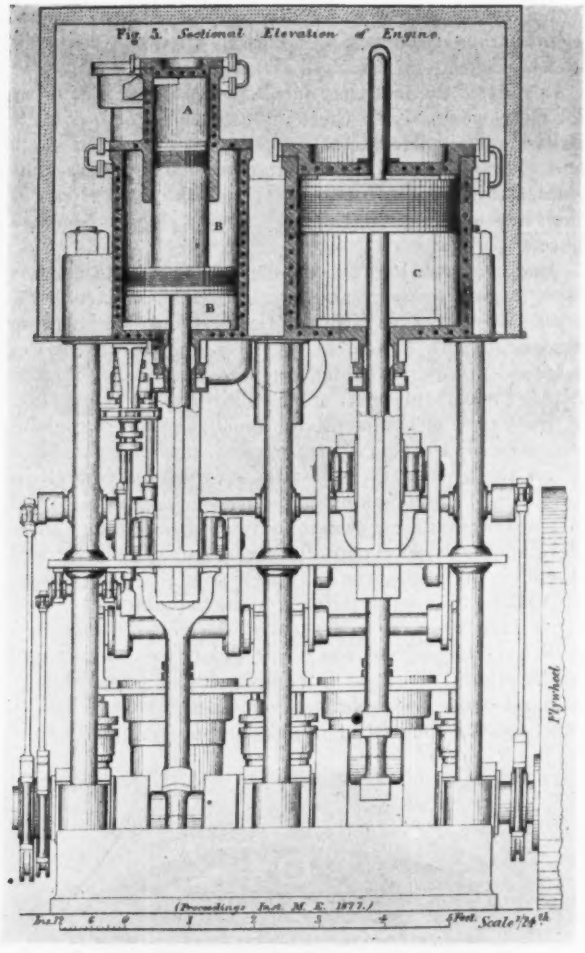
Jacob Perkins did not limit his proposed utilization of extremely high-pressure steam to the development of power in steam engines. He proposed and actually built a steam gun by means of which projectiles were fired by steam pressure at velocities comparing favorably with those then obtainable in muzzle-loading cast-iron cannon using ordinary gunpowder. He demonstrated his steam gun to no less an authority than the Duke of Wellington, who is reported to have been much impressed by the possibilities of the invention, though he feared that the rapidity with which it fired would lead to an appalling waste of shot! Other military authorities, however, rejected the steam gun, and it never got beyond the experimental stage, though A. M. Perkins tried to revive the idea at the time of the Civil War.

In spite of the fact that Jacob Perkins lived in London for many years, dying there in 1849, he never became a British subject. He was so stanch an American in spirit and character that his son and grandson always considered themselves Americans, though the greater part of their lives was spent in England, where the grandson was born.

Angier March Perkins, the son of Jacob Perkins, was born in Newburyport and lived in America until 1827, when he followed his father to England and there became associated with him in his business and also in his researches into the use of high-pressure steam. Undoubtedly A. M. Perkins inherited much of his father's talent, and at least part of the credit for Jacob Perkins' successful inventions in the field of printing and engraving should be given to the son. Shortly after establishing himself in England, A. M. Perkins introduced a successful forced hot-water circulating system for heating buildings, and he developed a large and profitable business designing and installing heating systems of this type in public buildings. In 1843 he took out a patent for the manufacture of iron by a method using superheated steam to remove impurities. The method was never widely used, but it is of some interest because it contained the germ of subsequent discoveries relating to the conversion of iron to steel and the elimination of phosphorus and sulphur from



The Perkins water-tube boiler of the Anthracite *was constructed of wrought-iron tubes three inches in diameter, their ends closed by welding. Short lengths of wrought iron with right- and left-hand threads connected the horizontal tubes. The firebox was surrounded by tubes. Vegetable black insulation was used between the inner and outer sheet-iron casings of the boilers.*



This is not the engine of the Anthracite *but a typical Perkins stationary engine of similar design. The single-acting high-pressure cylinder is marked "A," the lower part of the cylinder below it being utilized as the single-acting intermediate-pressure cylinder. The space above the intermediate-pressure piston was connected to the valve chest of the low-pressure double-acting cylinder "C," so that any leakage that passed the rings of the high-pressure and intermediate-pressure pistons would be caught and utilized in the low-pressure cylinder. Note the wrought-iron heating coils embedded in the cast iron of the cylinder walls. Steam at boiler pressure was used in these coils to heat the cylinder walls and reduce condensation losses.*

iron. One of A. M. Perkins' most successful, widely used, and profitable inventions was a heating system for bakers' ovens, using steam at a pressure of 2,000 pounds a square inch. He also invented a type of low-pressure steam boiler in which the heat from the fire was transmitted to the boiler by a closed circuit containing distilled water and steam at exceedingly high temperatures and pressures. Among his minor inventions was a right- and left-hand screw joint for high-pressure piping. The care and skill with which both Jacob and A. M. Perkins carried out their work with high-pressure steam are attested by the fact that no dangerous accidents ever occurred in any of their experimental or practical work. A. M. Perkins died in London in 1881 at the age of 81. At the time of his death, his inventions in both printing and engraving and in steam heating were widely used in Europe and America.

Loftus Perkins, the son of A. M. Perkins, was born in London in 1834. His early life was spent in London but like his father and grandfather, he considered himself an American. In 1853, he came to New York, where he practiced as an engineer for over a year. Returning to England, he rejoined his father and worked with him until 1862, when he went to Germany and lived in Hamburg and Berlin for four years, designing and installing heating systems of the type developed by his father. Returning to England in 1866, he re-entered partnership with his father and continued the association until the death of the older man.

When Loftus Perkins took up the development of his grandfather's idea for improving the efficiency of steam power plants by the utilization of extremely high pressures, he had at his disposal the engineering profession's growing knowledge of thermodynamics and the greatly improved materials and techniques of the Sixties and Seventies. Evidently he realized that the higher pressures with which Jacob Perkins had experimented were impracticable and that something would have to be done to reduce the condensation losses in the cylinders of his high-pressure engine. His researches led him to develop a simple type of water-tube boiler which could be operated safely at pressures of from 400 to 500 pounds a square inch and a somewhat peculiar type of triple-expansion engine which became known as the "Perkins engine."

To avoid the necessity of exposing piston rod packing to extremely high temperatures, Perkins made the high-pressure cylinder of his engine single acting. The intermediate-pressure cylinder was also single acting and was mounted below the high-pressure cylinder as shown in the accompanying drawing. The low-pressure cylinder was of the ordinary double-acting type fitted with a slide valve. The high-pressure and intermediate-pressure cylinders were fitted with poppet valves lifted by cams mounted on rockshafts actuated by eccentrics. In marine engines, reversing was accomplished by link motion on both the slide valve gear of the low-pressure cylinder and the poppet valve gear of the high-pressure and intermediate-pressure cylinders. The cylinders were heated by means of wrought-iron pipe coils embedded in the cast iron of both the main cylinder castings and the cylinder covers. To reduce radiation losses the cylinders were heavily lagged. The piston rings and piston rod packing of the Perkins engine were made of a copper-tin alloy which worked without lubrication. Rings of this metal were also used with considerable success in conventional engines.

In a paper published in the *Proceedings* of the Institution of Mechanical Engineers in 1877, Loftus Perkins described the machinery of the 57-foot launch *Emily*, which had then been running on the Thames for about five years. The little steamer had a triple-expansion Perkins engine taking steam at 500 pounds a square inch from a Perkins water tube boiler and exhausting into a surface condenser which furnished the distilled water required for boiler feed. In one trial the *Emily* steamed 60 miles in six hours on three hundredweight of coke costing but three shillings. Her success naturally interested the engineering profession in Perkins' work and no doubt led to the construction of two much larger marine power plants of the same general type.

The first of these was a paddle engine for a Tyne ferry, the *Loftus Perkins*, an old steamer which was renamed in honor of the inventor when the (*Continued on page 226*)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Festivities in February

Alumni Day 1944 to Be Held at Institute's Earlier Location; Paul G. Hoffman Is Announced as Guest Speaker at the Annual Banquet

ALUMNI Day 1944, to be held on Saturday, February 26, will be the third sampling of a substitute month in place of the traditional June as the occasion of Technology's annual gathering of good-fellowship. Commencement exercises, the 77th, scheduled this year for February 28, bring Alumni Day into the short month. In 1943, January was given a trial; in 1942, April. The program for Alumni Day this year is again of the shortened variety, the customary symposium being omitted. Class Day exercises for the Class of 1944 will be held on Saturday afternoon as usual, and the Alumni Day Banquet will take place that evening.

The site of the Institute's former home on Boylston Street will this year again be the scene of the festivities. The Class Day program, which will begin at two o'clock, will be held in New England Mutual Hall, in the building of the New England Mutual Life Insurance Company on Boylston Street in Boston, and the following tea dance will take place in a smaller hall in that building. The Classes of 1894 and 1919 will share in the Class Day program with the Class of 1944. The 50-year Class speaker is to be Alan A. Claflin, and Eugene R. Smoley will speak for the 25-year Class. Francis J. Chesterman, '05, President of the Alumni Association, will be toastmaster of the annual Stein-on-the-Table Banquet at seven o'clock in the Hotel Statler. President Compton during the evening will review the Institute's year, discussing the state of educational affairs beside the Charles as war demands and war research affect them. Paul G. Hoffman, President of the Studebaker Corporation, will be the guest speaker of the evening.

Class Reunions Summarized

As thus far arranged, the schedule of regular five-year class reunions, which this year are on the agenda for the classes of -4 and -9, is summarized below. The midwinter celebration of Alumni Day 1944 has occasioned some departures from customary practice.

1884 — No plans for any reunion.

1888 — Usual annual Webster dinner in June. Exact date and place to be announced later.

1889 — No plans at present. The reunion if held will probably take the form of a small gathering in Boston similar to other recent gatherings.

1894 — Fifty-year reunion to be held early in June. Plans to be announced shortly.

1899 — No reunion, except at Alumni Day banquet, February 26.

1904 — Plans not yet definite, but it is hoped that a reunion will be held in June.

1909 — No thirty-five-year reunion. See 1909 class notes in this issue of The Review.

1914 — Small reunion in June somewhere along the New Haven railroad, provided suitable facilities are available. A general announcement is to be sent out later.

1919 — Twenty-five-year reunion in July at some point in Connecticut. July 28, 29, and 30 tentatively set as dates.

1924 — Get-together on Alumni Day, February 26, with room at Hotel Statler.

1929 — No reunion planned, except at Alumni Day Banquet, February 26.

1934 — General reunion June 2, 3, and 4, Friday, Saturday, and Sunday, at a place to be decided later, probably somewhere in Connecticut. Henry B. Backenstoss, Robert M. Becker, W. Leslie Doten, Jr., and John A. Hrones are the committee in charge.

1939 — Tentative plans for a get-together on Alumni Day, February 26. Details to be announced later.

. . . Commencement . . .

Graduation exercises will be held in Symphony Hall at eleven o'clock on the morning of February 28. The invocation will be offered by Lieutenant Colonel Abbot Peterson, post chaplain at Camp Edwards, and the commencement speaker will be Claude Moore Fuess, headmaster of Phillips Academy, Andover.

Dr. Fuess was graduated from Amherst College in 1905 and holds degrees from Columbia, Yale, Princeton, Dartmouth, and Williams. He joined the staff of Phillips Academy as an instructor in English in 1908, a post which he held until 1928, when he was appointed Elizabeth Milbank Anderson Foundation Professor of English. Dr. Fuess has been headmaster of Phillips Academy since 1933. He is a member of the boards of visitors of Amherst College, Brown University, Harvard University, and the United States Naval Academy. He is also a trustee of Rogers Hall School and Governor Dummer Academy, as well as the Essex Institute and the American Antiquarian Society. During the last War he was civilian chief of the personnel division at Camp Joseph E. Johnston in Jacksonville, Fla., and later was commissioned a major in the Quartermaster Corps.

Dr. Fuess is a director of the Andover National Bank and a member of the Massachusetts War Memorial Commission, as well as the Headmasters Association, the Modern Language Association of America, the Massachusetts Historical Society, the American Legion, of which he is state historian, the Military Order of the World War, the American Academy of Arts and Sciences,

and the Amherst Alumni Council. In 1927–1928 he was president of the New England Association of Teachers of English. He has written widely in the field of biography and history, one of his best-known works being a biography of Calvin Coolidge.

. . . *Baccalaureate* . . .

Baccalaureate exercises will be conducted by the Rev. Carl Heath Kopf, minister of the Mount Vernon Church, Boston, and the baccalaureate address will be given by Major General Sherman Miles, commanding general of the First Service Command. The exercises will be held this year in Symphony Hall on Sunday afternoon, February 27.

General Miles was graduated from the United States Military Academy in 1905 and later attended the Army War College and the Command and General Staff School. He served successively in the Cavalry, the Coast Artillery, and the Field Artillery, and has held several posts on the General Staff. His service includes duty as a military attaché in Europe.

Honors

VANNEVAR BUSH, '16, former Vice-president of the Institute and now President of the Carnegie Institution of Washington and Director of the Office of Scientific Research and Development, has been awarded the Edison Medal for 1943. The medal, one of the most distinguished awards in the field of engineering, was presented by the American Institute of Electrical Engineers on January 26 at its technical meeting in New York.

Dr. Bush was chosen to receive the Edison Medal "for his contribution to the advancement of electrical engineering, particularly through the development of new applications of mathematics to engineering problems and for his eminent service to the nation in guiding the war research program."

As head of the Office of Scientific Research and Development, Dr. Bush directs application of the entire technical resources of the United States to the war effort. The Edison Medal is the second engineering honor bestowed upon him recently. In December he was the joint recipient with Samuel H. Caldwell, '25, of the John Scott Award, which is given annually by the city of Philadelphia for the development of useful inventions — in this instance, the differential analyzer.

Dr. Bush and Dr. Caldwell began their research on the development of mathematical devices several years ago when Dr. Bush was a member of the Faculty of the Institute, and the machines developed as a result of their collaboration have played an important part in war research.

The John Scott Award was founded by John Scott of Edinburgh, Scotland, in 1816, "to be distributed among ingenious men and women who make useful inventions." The fund is administered by the Board of Directors of City Trusts of the City of Philadelphia, and recipients are chosen by an advisory committee composed of representatives of the National Academy of Sciences, the University of Pennsylvania, and the American Philosophical Society.

Dr. Bush was graduated from Tufts College in 1913 and received the degree of doctor of engineering jointly from Harvard and Technology in 1916. He joined the staff of the Institute in 1919 as professor of electric power transmission and in March, 1932, he was named vice-president of M.I.T. and dean of its School of Engineering. His appointment as president of the Carnegie Institution of Washington came in 1938.

Professor Caldwell was graduated from Technology in 1925, receiving the degree of master of science in 1926 and the degree of doctor of science in 1933. He has been a member of the staff of the Department of Electrical Engineering since 1926, and has held the rank of associate professor since 1940.

Army Air Forces students in a meteorology class at Technology view the cryptic chart.

United States Army Air Forces

Major Jay Zeamer, Jr., of the Institute Class of 1940, receives the Congressional Medal of Honor from General H. H. Arnold, commander of the Army Air Forces, at the Pentagon in Washington. His parents witnessed the ceremony at which Major Zeamer's heroism as pilot in a mapping expedition over Bougainville last June was signalized.

Beyond the Call of Duty

THE nation's highest award — the Congressional Medal of Honor — was bestowed January 6 on Major Jay Zeamer, Jr., '40, for his heroic conduct as pilot of a Flying Fortress on a volunteer mapping mission over Bougainville Island in June. The citation:

"By direction of the President, I take pleasure in awarding the Medal of Honor to Major Jay Zeamer, Jr., Air Corps, United States Army, for service as set forth in the following citation:

"For conspicuous gallantry and intrepidity in action above and beyond the call of duty. On 16 June 1943, Major Zeamer volunteered as pilot of a bomber on an important photographic mapping mission covering the formidably defended area in the vicinity of Buka, Solomon Islands. While photographing the Buka airdrome, his crew observed about 20 enemy fighters on the field, many of them taking off. Despite the certainty of a dangerous attack by this strong force, Major Zeamer proceeded with his mapping run, even after the enemy attack began. In the ensuing engagement, Major Zeamer sustained gunshot wounds in both arms and legs, one leg being broken. Despite his injuries he maneuvered the damaged plane so skillfully that his gunners were able to fight off the enemy during a running fight lasting 40 minutes, and to destroy at least five hostile planes of which Major Zeamer himself shot down one. Although weak from loss of blood, he refused medical aid until the enemy had broken combat. He then turned over the controls but continued to exercise command and, despite lapses into unconsciousness, to direct the flight to a base 580 miles away. In this voluntary action, Major Zeamer, with superb skill, resolution, and courage, accomplished a mission of great value.

— Henry L. Stimson, Secretary of War"

Major Zeamer, a graduate in Civil Engineering, was a member of the Aeronautical Society, the American Society of Civil Engineers, and the Outing Club during his years at the Institute.

Toward Better Library Facilities

AT the October meeting of the Corporation, the Visiting Committee on the Library presented with its endorsement the following statement from the Faculty Committee on the Library:

The plans for a proposed library building presented to the Visiting Committee on the Library and discussed at its meeting in March, 1942, make it appropriate for the Faculty Committee on the Library, whose principal function is to advise on matters of policy, to present a succinct statement of the reasons why a new building is needed. The design and location of such a building would be finally decided upon by a special building committee. This statement is concerned with the functions such a building should serve — not with its architecture, its location, or how it is to be financed.

The Institute Library began with separate and widely scattered working collections of books and periodicals which had been found indispensable adjuncts to the teaching and research done by the several Departments. As these collections increased in size and value, proper supervision by trained librarians was found necessary. The Institute received by gift and bequest valuable collections such as that bequeathed by Theodore N. Vail. When the move to Cambridge was made, the original plan for the present buildings provided quarters for the central collections of the Library on the first floor of Building 10. Later, however, it was found necessary to assign the Central Library to its present far less satisfactory location in the Dome, which is relatively inaccessible, without adequate space for necessary administrative work, and with no possible provision for expansion. Twenty-seven years in this location have brought the Central Library to a somewhat congested condition.

Experience has shown the undesirability of concentrating in a single central collection the working library facilities of the major Departments of the Institute. Scientists and engineers must have the most frequently consulted books and periodicals located as near as possible

to their offices and laboratories. The present policy of grouping the working collections of several adjacent Departments in large branch libraries, such as Eastman or Lindgren, has in the past decade so thoroughly justified itself that it is no longer seriously questioned by anyone concerned. Without doubt such Departments as Biology and Biological Engineering and Electrical Engineering will in the near future desire and expect to have this policy extended to them. The case for a new library building does not therefore depend on the need for housing the everyday working collections of our major scientific and engineering Departments, since these are, or will eventually be, for the most part housed in large branch libraries conveniently accessible to their respective users.

The administration of the branches must, however, be centralized. There must be, as now, a card catalogue including every title the Institute possesses. There must be proper facilities for cataloguers and for the numerous other specialists on our library staff, as well as for the clerical workers who lift from these trained professional workers the burden of semiskilled routine tasks. There must be a centralized general reference collection. There must be adequate housing for rare and valuable books. Anyone who looks over our present Central Library with an open and inquiring mind will certainly conclude that its functions are indispensable and that the staff now charged with these manifold and often highly specialized tasks is constantly hampered in its work by badly designed and seriously overcrowded quarters. No alterations could possibly make adequate the present quarters of the Library under the Dome; no additions to the present quarters can be made; a move is long overdue.

Incidentally, the working collections of the Departments constituting the Division of Humanities could be most satisfactorily housed in a new library building. For these Departments the library is, in effect, a laboratory. Since their fields of interest overlap, a pooling of their library resources would be highly desirable. The effectiveness of instruction in such subjects as history, literature, and economics depends very largely on ample and accessible library facilities of a kind which could adequately be supplied at the Institute only by a new building.

The proper administration of the present library facilities of the Institute can be provided only by a new building. Moreover, the present and future position of the Institute in the educational world demands that henceforth a far broader view be taken of the function of our Library. It should serve as a center of scientific and engineering research. It should be in a position to offer better facilities for our Alumni and for industry. It should be in a position to attract gifts and bequests both of books and of funds. It should be a great library, outstanding in those branches of knowledge in which the Institute is preeminent.

The northeastern region, although geographically representing only a small fraction of territorial United States, is nevertheless the seat of a substantial proportion of American scientific and engineering research and enterprise. Technology must have the vision to develop its library resources and facilities so that it will inevitably become the center of this activity. Although other large libraries exist in this general area, their scientific and engineering resources are so diluted with and dominated by material primarily of interest to other fields that use of their resources is, in practice, tedious and difficult. The smaller, highly specialized libraries are so widely dispersed that integration of their resources by the individual user becomes prohibitively expensive in time and effort. By gradual but steady development and extension of our present very considerable collections, augmented by particular effort in supplementary services such as microfilming, photostating, bibliographic searching, preparation of reviews and surveys, and so on, the Institute can bring under one roof the most valuable and usable bibliographic research center in the whole northeastern region. Such eminent leadership as this is hopelessly beyond the scope of our present library plant; it can be realized, however, by adequate planning now for the future ahead.

The Institute Library has long striven to be as useful as possible to our Alumni in neighboring industries, and to industry as a whole. We have reference librarians who answer many inquiries, and we extend library privileges to many industrial concerns. But our ability to serve industry and Alumni has hitherto been in some respects limited by the obvious prior obligation to keep essential books as far as possible constantly available to our own staff and to students engaged in research. The working collections in Eastman and Lindgren, for example, are maintained primarily for the daily use of our own staff and students. Ideally speaking, those books which are likely to be needed by industry and by our Alumni should be duplicated. This would mean having a complete collection housed centrally in a new building, for the use of visiting research men and of any others to whom it seemed wise to extend the privilege. The branch collections would then consist largely of duplicate copies of books needed for working collections. Outsiders would seldom need to borrow books from these branch collections, which would be almost wholly reserved, as they perhaps should be, for the constant use of our own men. To attain this ideal would obviously be very costly. If, however, we are to extend a service to Alumni and to industry much beyond what is now offered to them, we must provide for a good deal of duplication of essential titles. Such duplication, where the fields of Departments served by different branches overlap, is an inevitable consequence of the policy of decentralizing departmental working collections, to which, as we have seen, we are already definitely committed. Further duplication merely extends the present policy in a somewhat different direction. A library in an educational institution, after all, exists primarily to serve the members and friends of that institution. Whether they need five copies of the same book or single copies of five different books is a matter of detail, not of principle.

Since it is evident that the provision of adequate housing is an essential basis for any further development of our library facilities, the Faculty Committee on the Library earnestly direct the attention of the Corporation Visiting Committee on the Library to the need of an ample and appropriate library building at the earliest possible moment (as soon after the war as new construction for nonwar uses becomes permissible). Such a building we believe to be necessary if the Institute Library is to be properly administered, if it is to serve as a center of research, if it is to offer adequate aid to industry, and if it is to take and hold the place fitting for the library of an educational institution of the first rank.

For Extraordinary Heroism

BREAKING his return journey from Cairo in December, President Roosevelt on a visit to Sicily decorated six American officers with the Distinguished Service Cross. One was Lieutenant General Mark W. Clark, commander of the Fifth Army fighting in Italy. One was Lieutenant William W. Kellogg of the Infantry, a year and a half away from Technology.

Lieutenant Kellogg, who was graduated from the Institute in Chemical Engineering in April, 1942, was active in undergraduate affairs, captaining the fencing team in his senior year, serving in the advanced Reserve Officers' Training Corps unit, being a field day marshal and a member of the pistol and rifle teams.

The story of exploits which were recognized by the President's bestowal of Lieutenant Kellogg's D.S.C. is best told by the citation which accompanied the decoration: "First Lieutenant William W. Kellogg, infantry. For extraordinary heroism in action from September 14, 1943, to September 28, 1943, between Paternapoli and Montello, Italy. As leader of an air-borne platoon, Lieutenant Kellogg landed with his men 40 miles behind enemy lines and for a period of 13 consecutive days in the face of constant danger and overwhelming enemy odds, courageously conducted outstandingly successful operations in enemy territory. During this period Lieutenant Kellogg personally led his men in disrupting telephone, power, and railroad lines, and demonstrated outstanding bravery and aggressiveness in his constant harassing of the enemy.

"In one night's action against superior enemy forces Lieutenant Kellogg gallantly led his band in the ambush of an enemy convoy, destroying two troop carriers and inflicting many casualties on the enemy. On September 24 he demonstrated personal heroism of the highest type in rescuing a severely wounded Allied airman whose plane was shot down behind enemy lines. In close proximity to the enemy and under intense aerial bombardment and a hail of fire from enemy guns, Lieutenant Kellogg, with utter disregard for his own life, made his way to the wounded man on an open hillside, carried him to cover, and succeeded in delivering him to friendly hands. Lieutenant Kellogg's outstanding personal valor, his inspiring leadership despite hunger, thirst, fatigue, and constant danger, and his exceptional devotion to duty no matter what the odds, reflect the highest traditions of the military service and are a credit to the air-borne forces of the United States Army."

Promotion

CARL M. F. PETERSON, '29, has been appointed superintendent of buildings and power at the Institute, to succeed the late Albert V. Smith, '20, whose assistant he had been since 1938. Mr. Peterson joined the staff of the Institute in 1929 as an assistant in the Department of Mechanical Engineering, became an instructor in 1931, and was promoted to the rank of assistant professor in 1939, serving until his present appointment. Following his graduation from the Department of Mechanical Engineering, he carried on graduate work and was awarded the degree of master of science in 1932. Mr. Peterson was born in Boston and prepared for the Institute at the Mechanic Arts High School.

M. I. T. Photo

Carl M. F. Peterson, '29, becomes superintendent of buildings and power at a time when the always busy Institute faces additional demands.

Greetings

FROM faraway Chungking a week before Christmas there came to the Institute renewed evidence that the long-standing close relationship between Technology and China continues strong as ever. The following exchange of radiograms, transmitted through the co-operation of Lieutenant Colonel Robert F. Seedlock, '40, in Chungking, records the event:

"Season's greetings to our alma mater from members of Chungking M.I.T. Club organized December 18.
—Y. H. Ku, President"

"M.I.T. welcomes new Chungking Club with hearty season's greetings to President Y. H. Ku and all members.
—Charles E Locke"

Technology groups in China in years past have set a good example to groups in the United States, maintaining organization and activities in spite of arduous conditions. The newly formed Chungking Club thus has a good tradition behind it. The opportunities for useful work available to Technology organizations in China were illustrated by the Technology Club of Shanghai a few years ago, in its successful program of raising money and conducting educational courses for young engineers which were recognized as of great value to the Chinese Republic.

President Ku of the Chungking Club was graduated from the Institute in Electrical Engineering in 1925, and continued directly with graduate study, receiving the degree of master of science in 1926 and that of doctor of science in 1928. He has been a member of the faculty of the University of Chekiang and of Tsing Hua University in Peiping before removing to Chungking.

Add Filial Roster

LISTS and statistics, with which educational institutions are rich in normal times, are among the earliest items to suffer dislocation as a result of wartime pressures.

Hence The Review with a blush here reports that its list of freshman sons of alumni fathers in the January issue was marred by an inadvertent omission. Included should have been Ralph Berman, son of Eli Berman, '18. As an alumnus father, Mr. Berman is doubly represented; another son, George, is a member of the present sophomore class. The total of sons of Alumni enrolled in the freshman class at the present time thus becomes 38, as compared with the 47 recorded a year ago.

Alumna and the Alloys

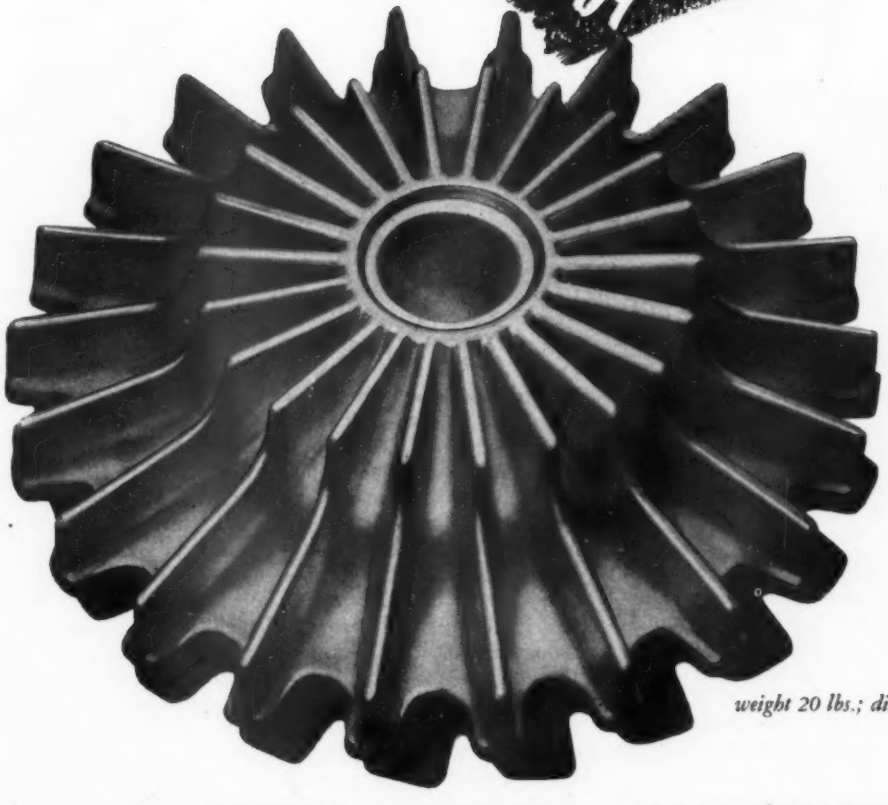
The Review takes much interest in its irregular series of sketches of the careers of notable Alumnae of the Institute, one of which is presented herewith. — ED.

WAR telegrams are handled accurately and speedily by wire materials tested and chosen by a brilliant Technology Alumna, Frances Hurd Clark, '22, chief metallurgist for the Western Union Telegraph Company. Some of the advances in the science of telegraphy — exemplified, for instance, by the increase in volume of traffic handled over a wire from 30 to 40 words a minute to as high as 2,800 letters a minute — can be credited to the tireless and successful (*Concluded on page 234*)

M. I. T. Photo

Mezzanines assuring efficient utilization of space in the Richards Mineral Dressing Laboratories also offer pictorial interest.

ALUMINUM DIE-PRESSED FORGING by REVERE



weight 20 lbs.; diameter 10¼"

AN INTEGRAL PART OF A TURBO-SUPERCHARGER

The impeller illustrated above—when machined and in assembly—is destined to become an integral part of a Turbo-Supercharger.

It is typical of the strong, close-grained, intricate die-pressed aluminum forgings in which Revere has pioneered so successfully. Revere forgings are also available in copper, various copper-base alloys and magnesium. Almost any shapes and sizes can be had, even those ordinarily pronounced "impractical" or "impossible".

Revere will be glad to offer—*without obligation*—technical advice on any special problems you may have in die-pressed forgings. Write Executive offices.

FREE! A 54 page manual, "Revere Copper and Copper Alloys—Technical Information for Product Designers," with 106 graphs relating to physical and metallographic properties under varying conditions; also, a new, easy-to-read chemical and physical properties chart, with pertinent illustrated information on Revere manufactured forms and welding technique. A complimentary copy sent you upon request. Address: Executive Offices.

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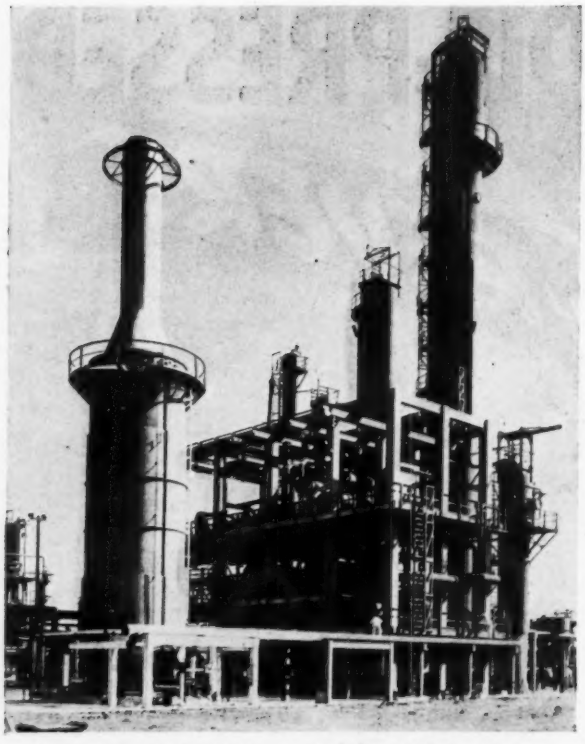


Acetone extractive distillation unit of the Humble Oil and Refining Company, Baytown, Texas

THE RUBBER SITUATION

(*Continued from page 196*)

of the rubber industry have done an outstanding job of expansion and production to meet the emergency. During the past year, about 167,000,000 pounds of camelback (formed, compounded rubber tread stock) were distributed for recapping passenger car tires and about 59,000,000 pounds for truck, bus, and Army tires. These figures compare with the total of approximately 105,000,000 pounds of all types of camelback which was distributed in 1942.

Having thus surveyed the major factors entering into the rubber equation, let us translate them into figures. The following two tables summarize the story. Table 1 shows in long tons the actual use of crude and synthetic rubbers in the United States during 1943 and estimates of requirements for 1944.

TABLE 1

	1943	*1944*
Military	268,400	390,000
Trucks and busses	81,400	145,000
Passenger car tires	42,500	184,000
Other indirect military and civilian uses	32,100	38,000
Total	424,400	757,000
Exports	73,500	146,000
Canada	33,100	50,000
Grand total (long tons)	531,000	953,000

Balancing what we have used and must use against what we have had and shall have, Table 2 shows that the synthetic rubber program really got under full way just in time to safeguard us against disastrous difficulties, and makes plain why we must look forward to continuance of restrictions for some time.

TABLE 2

	1943	*1944*
Inventory, January 1 (long tons)	443,000	205,000
New supplies		
Crude	60,000	81,000
Synthetic	233,000	818,000
Total	736,000	1,104,000
Requirements	531,000	953,000
Balance, December 31	205,000	151,000

The stock pile by the end of this year is expected to be some 54,000 long tons less than on December 31, 1943. And a larger proportion of it will be in synthetic rubbers, so that our crude stocks will be below the irreducible minimum recommended by the Baruch Committee. Restrictions on the use of crude rubber will be increased during 1944, until we have reached the ultimate objective of practically complete conversion to synthetics (for all but a few large tire sizes, and so on) and are able to live within our income of new crude receipts. Once the rayon cord shortage is overcome, we shall not be under the necessity of dipping so deeply into crude reserves for the production of the heavy highway tires of large size and the large airplane and construction-equipment tires which now cannot be made of synthetics.

Quantitatively, then, we can rightly expect to see all the vital military needs of the present fully met, to see essential civilian transportation maintained, and to see a gradual improvement of the general situation which will in due time permit relaxation of restrictions. But that relaxation cannot be considered as at present in sight; every owner of a car must realize that he is still in a position of trusteeship for the benefit of the nation in so far as his present tires are concerned, and that he is going to remain so throughout this year and well into the next.

Qualitative considerations, of extreme importance of course in the present situation, are perhaps even more conclusive when we look to the future. The great synthetic rubber industry which we have built in the past two years is here to stay; what sort of equilibrium will be reached between it and industry based on natural crudes will depend in great measure on the comparative performance and relative cost of the products. Hence the service which synthetic rubber is now giving in military applications to win the war is valuable as a measure of questions of adjustment and adaptation after the peace.

There need be no fear that synthetic passenger car tires will not be adequate. That statement does not mean that the miracle-man everlasting tires some people talk about are just around the corner; on the contrary, no evidence is available of just how such a tire could be produced. It does mean that today's high-grade passenger car tire made from all-synthetic rubber is as good a tire as all but the top-grade first-line tires made from crude rubber a few years ago. In even the short time that Buna S has been available in quantity, the rubber companies have made tremendous progress in learning how to work with this new material. The difficulties of milling which were a hazard in the utilization of Buna S are steadily being overcome. (*Concluded on page 214*)

When the lights go on again in Grigoriopol

Three short years ago Grigoriopol was a thriving city of the Russian Ukraine. Today it is a scene of desolation . . . victim of ravaging Hitlerite hordes.

But some day—soon we hope—lights will go on again in Grigoriopol, and in other Allied cities now under the Nazi heel.

When that time comes . . . thanks to a new idea in modern warfare . . . emergency electric power will be available to revitalize industries in war torn cities—immediately after they are retaken from the enemy.

This new idea—a self-contained POWER-TRAIN—has now been made a reality by the engineering brains and skill of Westinghouse.

Ten of these POWER-TRAINS are now being built by Westinghouse for use by the United Nations . . . each a complete 5000 kw power house on wheels, big enough to serve a community of 15,000.

Each POWER-TRAIN consists of 8 cars. Ingeniously assembled in these cars are: a 5000 kw steam turbo-generator, boilers, power stokers, boiler feed pumps, air-cooled condensers, auxiliary Diesel engine, living quarters for the crew—even conveyer equipment for handling coal which will be mined locally for fuel.

Because cooling water is not always available, air-cooled condensers are used to recover, as water, a high percentage of the exhaust steam from the turbine.

From switchgear to turbo-generator, each POWER-TRAIN is a complete 5000 kw mobile power house, ready to go to work at a few hours' notice . . . *in sub-zero cold or tropical heat of the desert.*

And remember—the same Westinghouse engineering brains and skill that developed the POWER-TRAIN will be available, after Victory, to create and build better products for you.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

Tune in John Charles Thomas, NBC, Sundays, 2:30 p.m., E.W.T.

Westinghouse

Plants in 25 Cities Offices Everywhere

WANTED
for the
PHILCO ENGINEERING STAFF

- **RADIO—ELECTRONICS—ELECTRICAL ENGINEERS**
  Men with degrees in electrical engineering or comparable experience in radio and television.
- **MECHANICAL ENGINEERS**
  Men with college degrees or comparable experience in the engineering aspects of electrical appliances, and in designing small machinery.
- **DESIGN ENGINEERS — DRAFTSMEN**
  Men with experience in mechanical designing, especially of small metal parts and of the automatic machinery to mass-produce them.
- **PRODUCTION ENGINEERS**
  Including electrical and mechanical engineers familiar with any phase of radio, radio-phonograph and television production.
- **PHYSICISTS**
  Must have science degree in physics. Some practical experience in radio is desirable.

FOR these and other key positions—senior and junior engineers for research, project and design work, physicists and mathematicians — we are looking for men who are thinking about the future. Right now there is plenty of urgently needed war work to do. But some day peace will return — and Philco is planning to be ready for it with advanced Radio, Television, Refrigeration and Air-Conditioning products. This may be your opportunity to get ready for it too.

WRITE US TODAY

Qualified men not now engaged in work requiring their full talents, are invited to write us in detail as to their experience, education, family and draft status, and salary. Letters will be treated in strict confidence.

Employment subject to local W.M.C. rules.

WRITE TO MR. GEORGE DALE

PHILCO CORPORATION
Philadelphia 34, Penna.

THE RUBBER SITUATION

(*Concluded from page 212*)

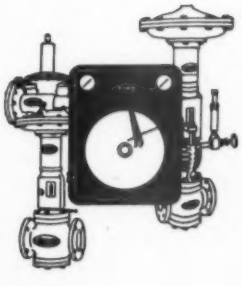
As part of the rubber program, extensive testing facilities have been made available for the development of products made of synthetic rubbers, which are being manufactured commercially only after performance tests have indicated that they will give adequate service. The same applies, of course, to synthetic rubber products for military uses. On the basis both of these tests and of recorded service, it cannot be overemphasized that in two respects Buna S suffers more sharply than does natural rubber from the deleterious effects which heat exerts on any tire. When any rubber is subjected to repeated alternate compression or elongation, heat is generated. In Buna S, more heat is generated than in natural rubber. But perhaps more serious, the decrease which heat produces in tear resistance and other qualities is much greater in Buna S than in natural rubber. Consequently, under identical running conditions, the compounded synthetic stock will not, at high temperatures, stand as much abuse as will the natural rubber stock. Greater care, therefore, must be given to synthetic than to crude rubber tires. If properly inflated, properly loaded, and not abused, these synthetic tires can be driven at reasonably high speed over smooth roads to give 90 per cent or more of the tread wear of first-line pre-war tires.

The ultimate costs of the various synthetics and the raw materials that go into them cannot yet be accurately predicted. It is safe to say, however, that after the war many of them will be available at prices far lower than were ever contemplated in the past. The efficiency of processing, operation, and management in our synthetic rubber establishments is increasing daily, yet months must necessarily elapse before the optimum is reached. Some constituent materials, notably alcohol, are being used at prices several times those of pre-war days. And under today's conditions there is no time to determine the by-product values that unquestionably lie hidden in the wastes from many of the plants, especially those producing butadiene from alcohol.

Future direct manufacturing costs will be affected by all these factors. Postwar amortization and financial charges will be influenced by the extent to which abnormal and normal costs of building the program are written off as "cost of war." Raw materials from some sources can be had at less cost than can the same materials from other sources, but the conditions may be reversed after the war. Though some of the processes now being used may not be economically competitive under postwar conditions, others have every reason for becoming permanent parts of the postwar economy. Reckoning all these factors, we may conclude that certain combinations of low-cost raw materials probably will give a postwar direct cost for Buna S of less than 15 cents a pound.

In any event, we may feel sure that the all-out effort of engineers, technicians, and scientists to establish the rubber program in time, and the patriotic contribution of the rubber, chemical, and petroleum industries in pooling for the public interest secret practices and formulas formerly guarded as the lifeblood of individual firms, not only will have prevented national disaster in time of war but also will have laid the basis for the permanent establishment of a new and essential industry in time of peace.

The 10,600-mile stretch...



Before the Japs had conquered the East Indies, America's scientists and chemists planted miniature rubber plantations in the United States by creating synthetic rubber.

From Massachusetts, 10,600 miles away, came Masoneilan controls which made possible the processes which have enormously stepped up the production of rubber ... American made rubber ... and prevented the loss of Far East supplies from being a major disaster.

MASONEILAN

MASON-NEILAN REGULATOR CO.

1197 ADAMS ST., BOSTON, MASS.

New York Philadelphia Pittsburgh Tulsa Toledo Chicago
Atlanta St. Louis San Francisco Los Angeles Houston
Mason Regulator Co. of Canada, Ltd., Montreal, Canada

PRINTING PRESS *vs.* TYRANNY

(*Continued from page 199*)

which folded shortly after Simon's flight, could well be those of practically any of the secret newspapers. Most of them encounter the same difficulties and problems in securing their supplies, in printing, and in distribution.

Supplies were first obtained, in the main, by theft; but as the need for greater quantities increased and the Gestapo grew more vigilant, supplies were supplemented through the conniving of patriots who juggled warehouse records and made secret shipments to the operators, or through undercover paper salvage drives.

Printing the papers is always hazardous. Many have been forced to move their locations as often as 50 times during the several years they have been publishing. Usually they have been tipped off well in advance that the Nazis were on their trail, and so have made their escape with time to spare, taking their equipment with them. On other occasions they have fled only a few hours — or even a few minutes — ahead of the Gestapo. And all too frequently they have been caught and martyred.

Distribution is handled through a number of trusted keymen who place blocks of the papers in the hands of district leaders who, in turn, divide them among others, and so on. The method is so set up that each distributor knows only two or three others of the organization. This is to preclude any chance of his divulging the names of more than that number of accomplices if he is caught and faces the dreaded Gestapo "persuasive" treatment.

People of all social classes volunteer their time and money in the service of the underground press, either in distributing copies, gathering information, or supplying equipment and materials. In Belgium some of the most zealous of the peddlers are children, who daringly go everywhere with their copies and are reported to have pinned pamphlets even on the backs of nazi soldiers riding in busses and streetcars. In Yugoslavia a decrepit, shabby septuagenarian carrying editorial copy for an underground paper passed under the nose of the Nazis regularly. Only after many months did they discover that this harmless-appearing old derelict carried the papers in the cane which he used to help him limp along the road. As a result he and his family were shot.

Although it is generally understood among readers that the papers are common property and are to be passed on after being read, many carry such instructions on the front page. Hence while a paper may print only 1,000 copies, as many as 10,000 or more persons undoubtedly read that issue. Copies of the papers are to be found everywhere: in theaters, restaurants, railway stations, busses, streetcars, rest rooms, and churches; many are even being read and handed on in the streets. Although the Nazis have tried every means, they have been unable even to slow the flood of underground publications.

In the main the papers have common objectives, although each does its bit to spread the individual tenets or beliefs of the organization or political group which publishes it. In France the church is quite active in the underground press, and the Catholics and Protestants have lately combined efforts in the publication of one paper. A significant feature of the secret press in all the occupied lands — an aspect which may indicate a trend toward labor-dominated governments — is the prominent role played in publication by labor organizations, trade-union groups, and other leftist associations. The communists and socialists are exceedingly active in the underground press of all the occupied countries.

Contents of the papers include local items, propaganda, editorials, instructions in acts of resistance, exhortations to sabotage, and current war news in areas where the population is unable to keep up to date through radio reception. The papers also meet an important need by exposing nazi sympathizers and by informing the people about — and thus putting them on their guard against — impending German "co-operation" programs, which the editors have an uncanny knack of uncovering before they have been announced. They also carry accounts of atrocities and list the names of those executed, imprisoned, or pressed into the German labor corps. Most of the publications regularly discuss postwar programs.

Each of the occupied countries, perhaps because of national psychology, has emphasized certain types of propaganda, and these leanings have been reflected in the columns of their respective clandestine papers. In Yugoslavia the activities of the guerrilla warriors under General Mikhailovitch have been extensively reported, and lately Tito and his forces have come in for considerable attention. Because of the political differences between these two leaders, however, there has been a split in the underground press, each group rallying behind its particular champion — Mikhailovitch being looked upon as strongly nationalistic and Tito being supported by the communists. But both continue to fight the Germans.

The extreme cruelty and ruthlessness of the Nazis in their dealings with the Poles have been highlighted by the Polish secret papers, which are packed with accounts of atrocities committed by the Germans, particularly upon the Jews, who are reported to have been massacred by the hundreds of thousands. The Jews have been put to death in all manners in the nazi pogrom, without regard for age or sex. A favorite method, according to one Polish paper's report, is to seal hundreds of Jews in boxcars, the floors of which have been covered with lime, and then ship them long distances without opening the cars for any reason. Any who survive the journey are immediately put to work at hard labor on starvation rations and most of them die soon thereafter. The Nazis find this method almost 100 per cent effective and cheaper than bullets.

A vivid account of a Jewish execution is the following from a Polish secret paper: "In Miedzeszyn the Nazis planned to kill 250 children in the Medem sanitarium for Jewish workers' children. The place was surrounded and the personnel ordered to leave. Most of the staff, knowing what was coming, refused to abandon the children to their fate. All, adults and children, were shot."

Another: "On the night of March 25, 1942, all Jews in the Lublin district were driven from their homes. The sick and crippled were killed where they lay. More than 100 children, ranging in age from two to nine years, were taken from a Jewish orphanage, led to the outskirts of town, and murdered with their nurses. Over 2,500 persons were massacred that night; the remaining 26,000 Jews were moved to a concentration camp at Belzec. In Radom, the Gestapo visited the ghetto every day, killing all Jews they found in the streets and yards."

Most French papers point to General de Gaulle as leader of the country and recognize him alone as the representative of the French people. They have relentlessly

(*Concluded on page 218*)

TYGON TUBING — A BETTER PIPING MEDIUM FOR GAS, AIR, AND LIQUIDS

EXTREMELY tough, highly resistant to abrasion, immune to the action of most corrosives, Tygon plastic tubing is finding unlimited use in industrial applications that formerly could be met only by metal or rubber.

Tygon tubing is available in any desired degree of flexibility — as rigid as bone, or as flexible as twine. Certain formulations retain their flexibility at temperatures as low as –70° F. Tygon tubing may be made glass clear, translucent or opaque, or in an almost unlimited range of color. Extruded to rigid dimensional accuracy, Tygon tubing is stocked in a wide range of standard sizes. It can be made in varying wall thicknesses and in virtually any shape cross-section desired.

Tygon tubing is acid-and-corrosion proof; is unaffected by oils, gasoline, alcohols or water; unlike rubber, it is not subject to oxidation and will not chemically deteriorate with age; nor will it scale nor tuberculate. Tygon tubing may be made completely non-toxic, of vital importance in food or drug processing. It will not affect the most delicate flavor or color.

Tygon's excellent dielectric strength; its ability to withstand repeated flexing, and its non-combustible nature, permit its use in applications where no other material has proven satisfactory.

Tygon tubing is used for acid, air and gas lines, for laboratory tubing, for gasketing, bumpers, conduits, channel strips, sleeving, bushings, in fact, for almost any purpose where a flexible, sturdy, highly corrosion-resistant tubing is required.

The basic characteristics of Tygon tubing are available in other Tygon formulations: Tygon sheet and gasketing materials; Tygon molded items; Tygon Paint; and Tygon liquid formulations for coating, dipping or impregnation purposes. Write today for the new Tygon Bulletin. Address your inquiries to The U. S. Stoneware Company, 6201 Tallmadge Circle, Akron, Ohio. If you live in Canada, to: Chamberlain Engineering, Ltd., Montreal.

U. S. STONEWARE
AKRON, OHIO

PRINTING PRESS *vs.* TYRANNY

(*Concluded from page 216*)

denounced the Vichy regime as well as all members of the Vichy group and strongly protested the Allied acceptance and recognition of Admiral Darlan as the French provisional chieftain. Because of his early association with Darlan in North Africa, General Giraud earned the mistrust of most units of the French secret press.

It is interesting that *Combat*, in its North African edition of November, 1942, predicted the death of Darlan. In the text of an article criticizing Allied allocation of power to Darlan, *Combat* wrote in part: "In default of Darlan, *whose days are numbered* [italics mine], of Giraud, who seems to fight shy of power . . . who will be given the power of government? . . ." Following the assassination of Darlan on December 24, *Combat* tacitly approved the act by commenting in its issue late in that month: "We did not love Admiral Darlan. His activities at Vichy since the defeat, his policy of collaboration with the oppressors of France, did not qualify him, in our eyes, to bring French Africa into the war of liberation for our country. Admiral Darlan is dead, the victim of a murder which we condemn, because we condemn murder. Peace to the ashes of Admiral Darlan." Whether the French underground was in any way responsible for the death of Darlan, and, if so, whether *Combat* was aware of the plot before it took place, or whether the paper's guess was just a guess is an interesting conjecture.

The French secret press is so powerful an instrument today that its reactions are carefully considered by Vichy and even by the Germans in the occupied zone. Distribution is reported to be perfected beyond that of any other country, and its sources of information are said to be so close to the authorities that they are able to introduce virtually nothing without its first having been revealed in the press. The scorn and contempt with which the Vichy regime is held by the press and the people are aptly summed up in new definitions of the units in the celebrated French motto of "*Liberté, Egalité, Fraternité*" which appeared in *Libération* in June, 1942:

"We thank you, gentlemen of Vichy, and we thank your Nazi masters.

"Your police and your prisons have taught us once more the meaning of Liberty.

"The imbecile, petty tyrants who represent you throughout the country have taught us once more the value of Equality.

"As for Fraternity — we have found it, against you and against your masters, in the faith which inspires us, in the immense enthusiasm which wells up in us and which, on the approaching day of liberation, will sweep you away forever."

The history of the underground press, when it is fully recorded, will bristle with tales of personal heroism and devotion to the cause of freedom, without counting the cost. For the present, however, this epic story must remain largely anonymous. Editors and printers of underground newspapers have done much to weaken the German war resources by discouraging all co-operation in German activities, by encouraging sabotage and reduced production in munition plants, and by organizing resistance to nazi oppression. More important still, they are preparing their readers to rise in revolt at the appropriate moment and see that as few of the occupation troops as possible live to leave the lands they have violated.

MATERIALS HANDLING EQUIPMENT
for All-Out Production
STACKERS • JACKLIFTS • SINGLELIFTS • HYDRAULICS • FLOOR TRUCKS • SKIDS • POWER FORK TRUCKS
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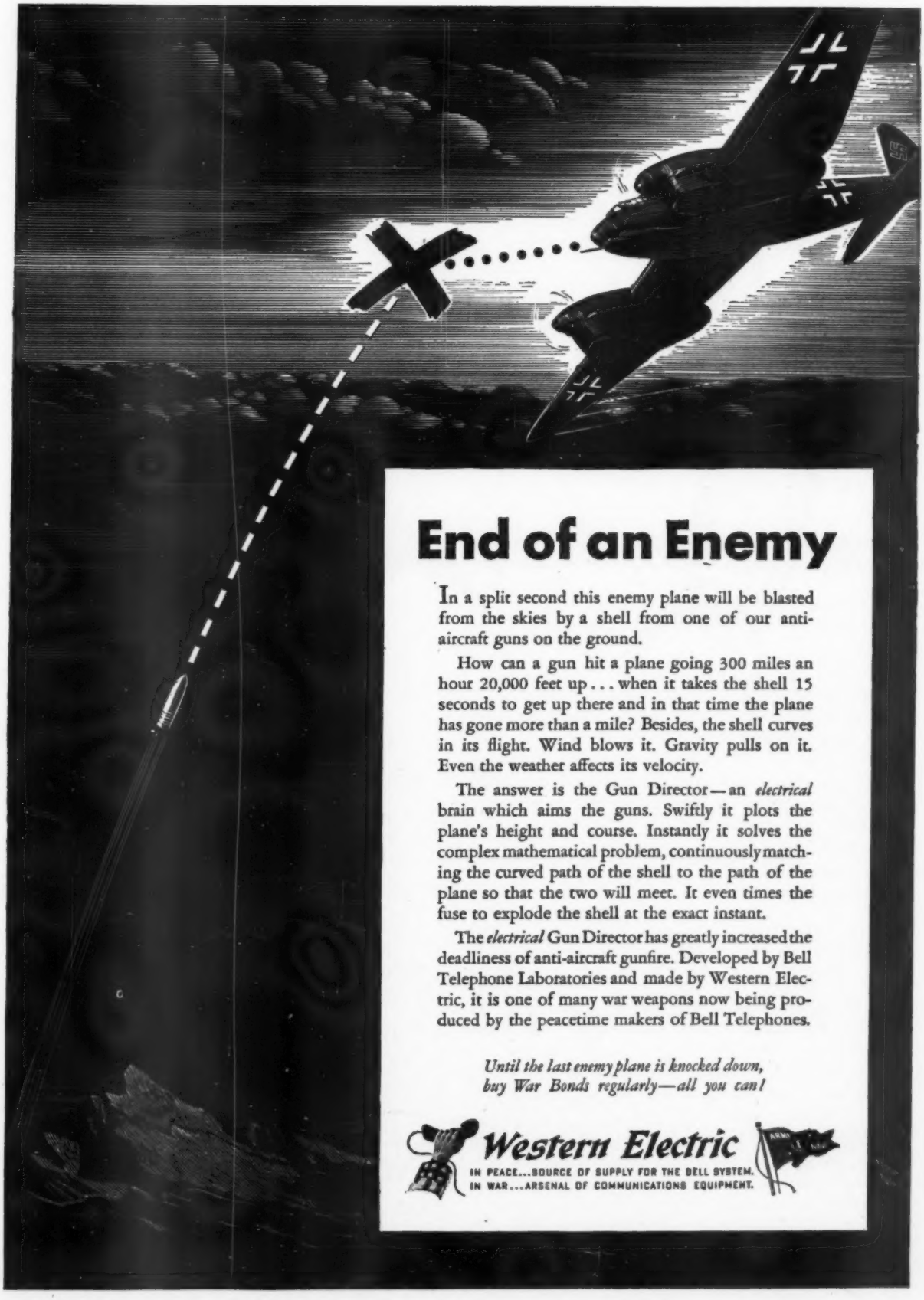
BUY WAR BONDS—FOR VICTORY TODAY AND SOUND BUSINESS TOMORROW



End of an Enemy

In a split second this enemy plane will be blasted from the skies by a shell from one of our anti-aircraft guns on the ground.

How can a gun hit a plane going 300 miles an hour 20,000 feet up . . . when it takes the shell 15 seconds to get up there and in that time the plane has gone more than a mile? Besides, the shell curves in its flight. Wind blows it. Gravity pulls on it. Even the weather affects its velocity.

The answer is the Gun Director—an *electrical* brain which aims the guns. Swiftly it plots the plane's height and course. Instantly it solves the complex mathematical problem, continuously matching the curved path of the shell to the path of the plane so that the two will meet. It even times the fuse to explode the shell at the exact instant.

The *electrical* Gun Director has greatly increased the deadliness of anti-aircraft gunfire. Developed by Bell Telephone Laboratories and made by Western Electric, it is one of many war weapons now being produced by the peacetime makers of Bell Telephones.

Until the last enemy plane is knocked down,
buy War Bonds regularly—all you can!

Western Electric

IN PEACE...SOURCE OF SUPPLY FOR THE BELL SYSTEM.
IN WAR...ARSENAL OF COMMUNICATIONS EQUIPMENT.

YEP, YOU! This time we're talking to *civilians.*

That other ad you have in your hand, we ran some months ago. It was addressed to service men — explaining the advantages of Uncle Sam's NATIONAL SERVICE LIFE INSURANCE, in which we sincerely believe and on which we don't make a nickel.

A flock of friendly letters thanked us for our advice, and many Army and Navy insurance officers seem to feel that the ad helped contribute to this very heartening fact:

Over 95% of the men in military service today have NATIONAL SERVICE LIFE INSURANCE *averaging better than* $9000 *for each man* — more than twice as much as the national *civilian* average per family.

Does this mean that *you* care less about *your* family than the fighting men do about theirs?

Of course not. It means simply that far too few civilians are realistic in recognizing the daily hazards that take their toll on the home front.

And even if you are one of those who own *more* than the service man's average, ask yourself this question — "Is my insurance coverage *enough* to give my family the security they need and deserve?"

If it isn't, why not *do* something about it? The solution is simple. For planned protection to fit your personal needs, call one of our *Career Underwriters.*

★ *BUY WAR BONDS EVERY MONTH* ★

To men about to enter the service

See your regular agent and arrange to keep your present life insurance *in force.* This is made easy for you, but there are papers to sign.

For your information, we have published a folder, "What the Service Man Should Do About His Life Insurance." A post-card to our Home Office in Boston will bring it to you.

Upon enlistment, be *sure* to take the full $10,000 of NATIONAL SERVICE LIFE INSURANCE to which you are entitled, *in addition* to the regular life insurance you already own.

New England Mutual
Life Insurance Company of Boston

George Willard Smith, President *Agencies in Principal Cities Coast to Coast*
The First Mutual Life Insurance Company Chartered in America—1835

Do civilians love their families less?

The advertisement on the opposite page points out the disparity between the life insurance estates of the average service man and civilian. Probably you're well above the national civilian average. But regardless of *amount*, two comments still apply.

1. Wartime tensions—extra work and worry — may make you uninsurable. 2. Wartime changes — in family or finances—may upset your insurance set-up. And either can happen without your realizing it.

Every life insurance program ought to be reviewed regularly to keep it up to date. Perhaps yours needs it now. Below is a list of people who can counsel you.

They're alumni of your college and they talk your language. They are also trained representatives of the First Mutual Life Insurance Company Chartered in America.

Out of their experience you'll get *practical* suggestions. They'll help you make the most of your limited life insurance dollars—help you protect your present policies with premium loans if necessary.

RAYMOND P. MILLER, '18
Salem

ARTHUR C. KENISON, '19
Boston

BLAYLOCK ATHERTON, '24
Nashua

If none of these folks is near you, just use the coupon below.

NEW ENGLAND MUTUAL LIFE INSURANCE COMPANY OF BOSTON
Box 1-5, 501 Boylston St., Boston 17, Mass.

Please have one of your representatives get in touch with me, without obligation on my part.

*Name*_____

*Street*_____

*City*_____

*State*_____

AMERICA'S NEW FRONTIER

(*Continued from page 201*)

dence of backwardness is the fact that very few of our educational institutions have adequate planning courses. The outlook of city planning, moreover, often is not so broad as the problems involved demand. For the accomplishment of the kind of advanced thinking which is imperatively needed, much information on the condition of cities and on the purpose of a planning program must be collected.

7. *Real-Property Inventory.* A new idea, the real-property inventory is an audit of the properties in a city, evaluating vacancies, the physical condition of buildings, and other elements important in determining replanning problems. We actually know little or nothing about the condition of our cities from the economic, social, and physical standpoints. The real-property inventory hence should be a going concern in every municipality, for sound planning can be done only on a basis of sound factual information.

8. *Land Values and Administrative Costs.* On few subjects has more misinformation been circulated than on land value. Use is the true determinant of the value of land, which may yield no return when it is badly administered and which, even if inferior, may yield appreciably if well administered. In spite of this fact, land values in our large cities have been raised out of all proportion to their actual use value, through continued speculation. The use value of low-cost housing certainly indicates that land on which subsidized housing is to be built should be low in cost. Yet in some of our large cities, housing projects are erected on land costing from $1.00 to $5.00 a square foot — $40,000 to $200,000 an acre. If we limit the number of families per acre to 20, we start our subsidized low-cost housing with a charge as high as $10,000 per unit for land before we have even started to erect the building. As a result, we have found ourselves subsidizing housing, including land and building, from $15,000 to $16,000 a unit. The absurdity of this procedure needs no further illustration.

9. *Control of Land Use.* Some people advocate government ownership of all the land, one proposal being that land in the cities should be bought in at the appraised value and resold at a proper use value. One can imagine that the taxpayers of America would revolt at this proposal and insist upon a slower and economically sounder policy. Revision of the tax structure, removing some of the tax burden from land, will tend toward the reduction of cost. In some cases, owners will have to accept a reduction in the value of their land in order to provide for the use of it in the city redevelopment program. There is no doubt that control must be maintained over land use in order to prevent unregulated construction and the erection of nuisance buildings in residential areas, as well as other abuses of our present system of building cities.

10. *Improvement in Design and Construction.* It is a fact that before the war the manufacturers of automobiles were producing better cars at lower cost. It is also a fact that we were producing inferior houses at higher cost and that the relationship between the income of the American people and the cost of construction has made it impossible for us to carry on housing under private industry to the extent that we should. The public should be freed from the damaging effect of trade restrictions,

of combinations to prevent the introduction of new methods and materials, and of archaic, overrestrictive, and too specific building codes. A strong effort should be made to reduce the fluctuations characteristic of the building industry, in which the greatest activity takes place in periods of high prices, but building slows down, and mechanics and laborers suffer from unemployment in periods of low prices. A greater amount of prefabrication should be encouraged. Architects should help to dispel the erroneous impression that the purpose of prefabrication is to provide for demountability. Its true purpose is to transfer from field to shop as large a proportion of the work as can be effectively and economically assembled in advance. As they learn to design in terms of prefabricated parts, architects will learn that the discipline which is afforded by prefabrication is a stimulus to improved design.

11. *Private Enterprise and the Government.* During the past 20 years, much controversy has centered on the relationship between private enterprise and government ownership. The debate has been confused because many have been unable to distinguish between abuses of exploitation for private profit and liberty to initiate private enterprise and to derive a just economic reward therefrom. Here is opportunity for educational institutions to undertake clarification of an important issue.

12. *Housing Policy.* On a recent visit to America, Sir Ernest Simon commented on what he described as our lack of a housing policy. This is a true indictment against us. Most of our so-called government housing has resulted from studies of European housing built by nations with ideologies different from ours. The mass housing they produced was socialized and became subject to political abuses. Great Britain's housing policy permits no more than 12 families to the acre, and each family has a garden of its own. If we agree that any nation depends for stability on home ownership and the right to a piece of land, our continued construction of storage warehouses for human habitation is a tendency in the wrong direction. Many believe that following the war, new types of transportation will make it possible for people to live away from the crowded cities and yet do their work. If so, much present "housing" may well turn out to be a drug on the market. In all the discussion that rages about housing, we should keep in mind the fact that the crux of the problem lies in the disproportionate relation of the incomes of users to the costs of building. This disparity is the basis of the calls upon government to intervene with subsidies. It is for each of us to support a movement to cut housing costs all along the line — from the cost of construction, which is caused in part by obsolete building codes, to the costs of land, of taxation, and of finance. This done, the general program of postwar reconstruction should provide full employment at good wages and so greatly reduce the proportion of our population in the lower third of average annual incomes.

13. *Recreation Needs.* Reference has already been made in this paper to the huge crime bill of twelve billion dollars a year. We shall go nowhere in the solution of our crime problem until we eliminate juvenile delinquency, which J. Edgar Hoover declares to have reached the most alarming proportions in the history of America. The relation between juvenile delinquency and recrea-

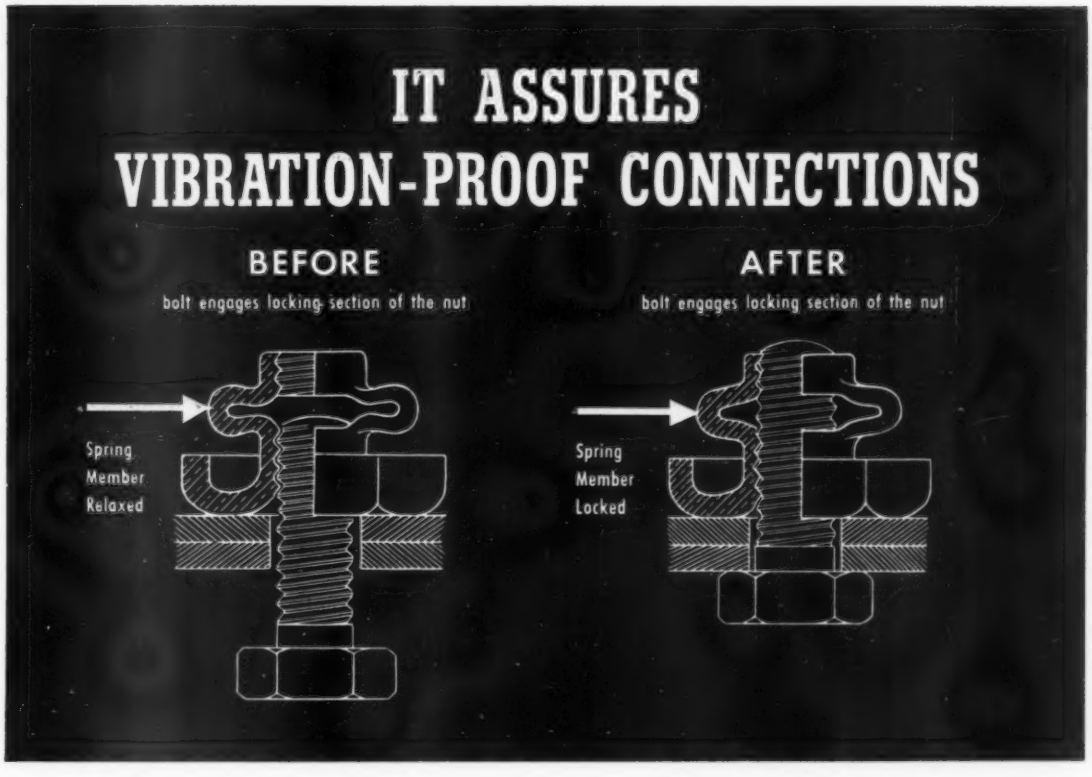
(*Concluded on page 224*)

POOR & COMPANY

RAILWAY EQUIPMENT

CHICAGO, ILLINOIS

IT ASSURES VIBRATION-PROOF CONNECTIONS



ELIMINATES AXIAL PLAY

The Boots Self-Locking Nut is one piece, all-metal—withstands severest vibration. The top (locking) section is displaced in a downward direction . . . locking threads are out of lead with load carrying threads of lower section.

Upon insertion of bolt, top section of nut is extended to engage with threads of bolt. A constant force is thus established which locks nut firmly into position. Axial thread play is eliminated.

OTHER ADVANTAGES:

1. Because Boots Nuts are *all* metal, they are not affected by the corrosive action of oil, chemicals or water.
2. They have greater re-usability in maintenance than other nuts.
3. They resist high temperatures.
4. They meet the exacting specifications of all government aviation agencies in an industry where loose fastenings could not be tolerated.

There's a BOOTS NUT for every application

ROL-TOP

BOOTS

ANCHOR

BOOTS AIRCRAFT NUT CORPORATION

GENERAL OFFICES, NEW CANAAN, CONNECTICUT

AMERICA'S NEW FRONTIER

(*Concluded from page 222*)

tional facilities is well known; it was recently emphasized by findings of the commission appointed by Mayor La Guardia in New York to examine school planning and construction, which showed from police records that where new recreation grounds had been provided and properly supervised, juvenile delinquency decreased 50 per cent in one year. The least important part of the crime situation is the cost in dollars; the most important is the lowering of the moral fiber of the nation. This problem must be reckoned with, since it is not only definitely connected with the political, economic, and social phases of planning but with the actual physical planning as well.

MANY other matters are of interest and importance to this program but are too large in scope for discussion here. Among them is planning of this kind for trade, business, and industry, which up to the present has received scant attention. Chaotic conditions exist in construction in this field. Another item is transportation and circulation. The automobile has made it imperative that consideration be given to traffic flow, parking, and related problems. In the matter of needed legislative assistance, work must be done on legislation with respect to money and credit, on delegation by state legislatures of authority to local subdivisions of government — the county, the city, the incorporated village — to undertake certain tasks for which they are best adapted in connection with planning.

Zoning and land use ordinances are of extreme importance in any rebuilding program. At present, these ordinances are generally chaotic and too much under political control. Another requisite is the passage of laws to permit the condemnation of land by private building corporations, illustrated in the New York redevelopment laws of 1941–1942 as amended in 1943. The police power to raze obsolete buildings and to regulate existing uses should be strengthened and given wider public support. Many buildings unfit for human occupancy are now illegally in use. Perhaps one of the most important questions is that of standardizing building codes on a national basis and passing basic legislation which will set up boards of standards and appeal with power to issue standard regulations to control type of construction and permissible materials.

Such a program as has here been outlined should engage the attention of all Americans interested in creating better living and working conditions in this country. Though it offers admirable aid in meeting the arduous conditions of employment and readjustment to be foreseen after the war, it is by no means a temporary expedient to meet an emergency. Rather, it is a long-term undertaking, made up of many separate divisions which can and should be approached individually by those best qualified to outline the proper action. This new frontier in America provides not only for architects, planners, builders, and engineers but also for all thoughtful citizens one of the greatest opportunities this country has ever experienced. This frontier can be mastered by men with courage and intelligence, and it must be mastered if our way of life is to be assured.

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HIGH-PRESSURE SALESMEN

(*Continued from page 204*)

high-pressure engine was installed in her. The engine was of the triple-expansion type, with single-acting high-pressure and intermediate-pressure cylinders and a double-acting low-pressure cylinder. The extremely low piston speed of this engine, however, did not lend itself to the effective utilization of the Perkins system, and many mechanical difficulties were encountered in the use of steam at 450 pounds a square inch in such large cylinders. After a few years the Perkins engine was removed from the ferry as a failure.

In the meantime, however, C. J. Lambert ordered the large steam yacht *Wanderer* from Messrs. R. Steele and Company and directed that she be fitted with engines and boilers of the Perkins type. The *Wanderer* when launched was one of the largest steam yachts afloat, her length being 175 feet and her beam 29 feet. Her engines were designed by J. F. Spencer with the co-operation of Loftus Perkins, and were of the usual Perkins triple-expansion type, the diameters of the cylinders being 17 inches, 34 inches, and 48 inches, and the stroke of all pistons 30 inches. The high-pressure and intermediate-pressure cylinders were single acting, as was usual in Perkins engines. Steam was supplied by four Perkins water-tube boilers working at 400 pounds a square inch. The maximum indicated horsepower of the engine was 907, at 92 revolutions a minute. As might have been expected with such a large engine of an unusual type working at an almost unprecedented steam pressure, many serious mechanical troubles developed. The troubles encountered do not appear to have been caused, however, by the temperatures in the high-pressure cylinder but by details with which there had been no particular reason to anticipate trouble. The glands of the boiler feed pumps leaked persistently, which was very serious when one considers the absolute necessity of using distilled feed water in boilers working at 400-pound pressure. This difficulty was finally overcome by installing on the feed pumps auxiliary glands which caught the leakage from the main glands and returned it to the hot well. The flat mica water gauges of the Perkins boilers also proved very difficult to read, and there was a great deal of unexpected trouble with the slide valve of the low-pressure cylinder.

As this cylinder did not utilize steam at pressures which were at all unusual, it is unfortunate that this trouble contributed to the ill repute of the *Wanderer*'s machinery. After correction of these initial difficulties, the *Wanderer* set out on a cruise which took her across the Bay of Biscay and into some exceedingly heavy weather which brought on further trouble with the power plant. Again it appears to have been details rather than fundamental mistakes in the design of the machinery that gave trouble. The most serious difficulty was caused as the vegetable black insulation in the sheet-metal casings of the boilers became compacted by the motion of the ship in such a way that practically no insulation was left in the upper parts of the casings. This fact resulted in the boiler room's becoming so unbearably hot that the stokers could not remain at work. The mica water gauges again proved unsatisfactory, and great difficulty was experienced in determining the water level in the boilers. Troubles experienced in this storm so thoroughly con-

(*Continued on page 228*)

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HIGH-PRESSURE SALESMEN

(*Continued from page 226*)

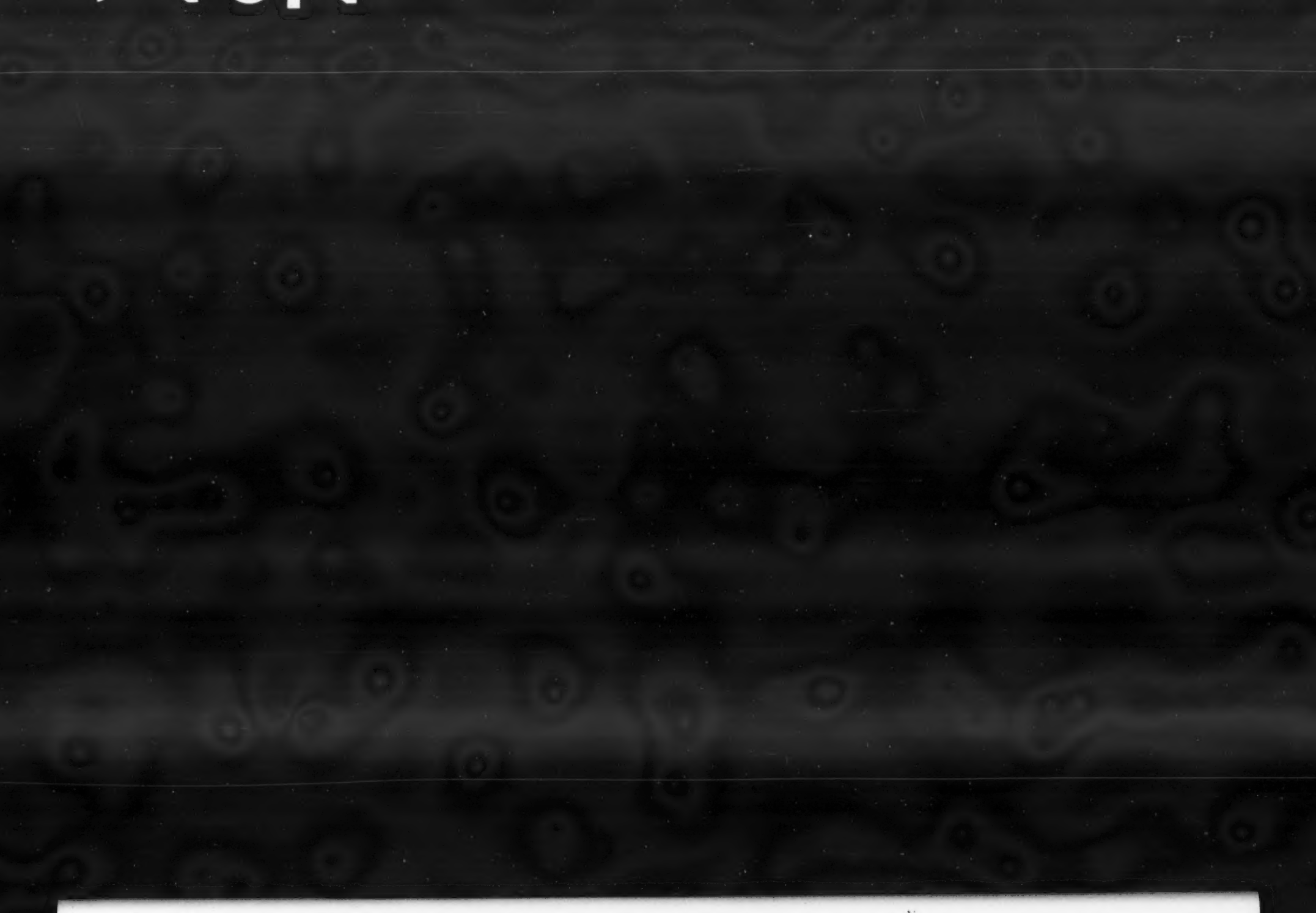
vinced Mr. Lambert of the impracticability of the Perkins power plant that he had the engines and boilers removed from the *Wanderer* upon the return of the vessel to England. She was thereafter fitted with an ordinary compound engine using steam at a pressure of about 80 pounds a square inch.

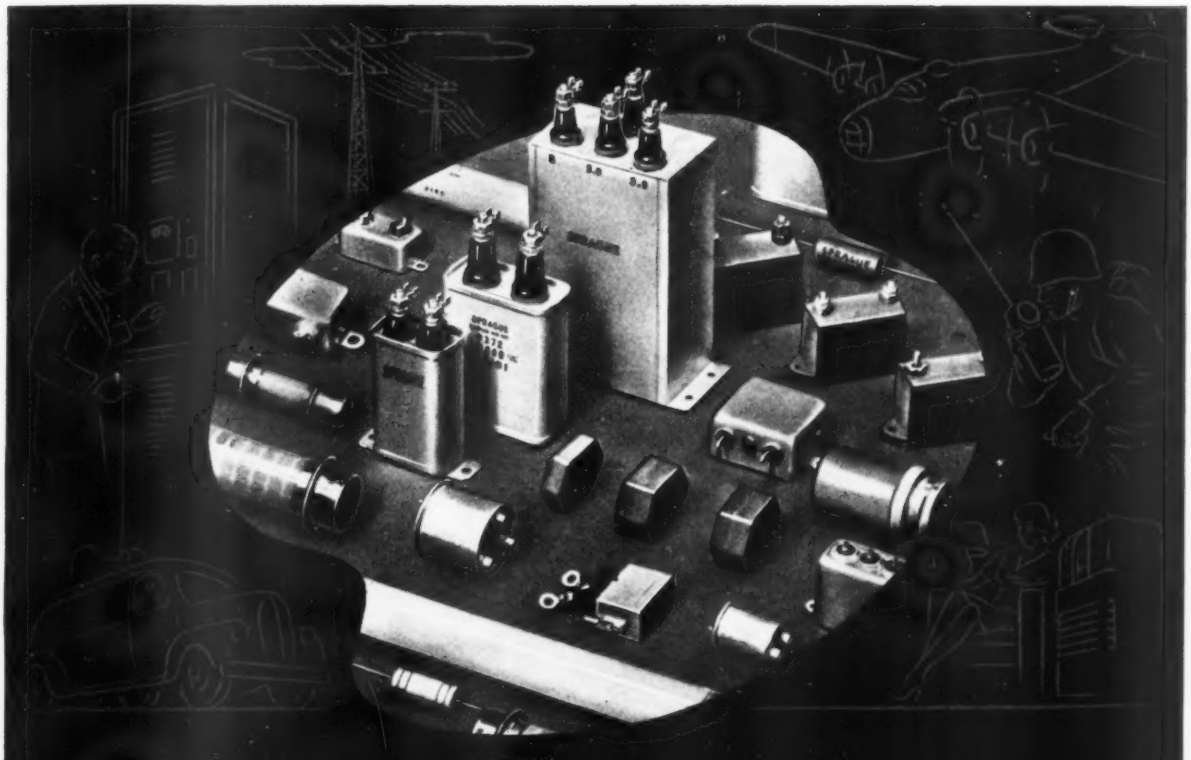
In spite of the failure of the machinery in the *Wanderer*, Perkins induced Richard Power of London to go ahead with his plan for the installation of a Perkins engine and boiler in the little steam yacht *Anthracite* which was then under construction at the yard of Tchlisinger, Davis and Company of Wallsend-on-Tyne. The engine of the *Anthracite* was of the usual Perkins triple-expansion type and was built by Messrs. Hawks, Crawshay, and Sons of Gateshead-upon-Tyne from designs by Loftus Perkins. The cylinder diameters were $7\frac{3}{4}$ inches, $15\frac{13}{16}$ inches, and $22\frac{13}{16}$ inches, and the stroke of all pistons 15 inches. The engine indicated 110 horsepower at 105 to 108 revolutions per minute. The water-tube boiler was built by the Perkins company in London. The *Anthracite* was a small vessel, her length on deck being but 84 feet, her beam 16 feet, and the depth of hold 10 feet. She measured 70 tons gross and 27 tons registered.

After a successful trip from the Tyne to London, the Perkins Engine Company invited a party of engineers to join the *Anthracite* for a demonstration run on the Thames. The little power plant was admired by those invited to witness this demonstration, and they were furthermore undoubtedly impressed by the results of tests made on the *Anthracite*'s machinery by a prominent engineer, F. J. Bramwell, who reported that the engine and boiler produced an indicated horsepower-hour on 1.7 pounds of coal. Interest in the *Anthracite* was further promoted by the fact that her owner had consented to send her on a voyage to America with the avowed intention of demonstrating the practicability of the Perkins engine and boiler.

The little vessel left Falmouth in June, 1880, having 16 tons of coal in her bunkers and 6 tons in bags on deck. She arrived safely at St. John's, Newfoundland, in 18 days, during which she consumed $19\frac{1}{2}$ tons of coal under her boilers and 1 ton in the galley. The *Anthracite* experienced much bad weather on the trip, having to lay to for a couple of days, and on many others meeting heavy head winds and seas. On June 24 she left St. John's for New York, encountering so much fog that the trip was a slow one. While in New York her power plant underwent a rather elaborate test at the hands of naval engineers at the Brooklyn Navy Yard. This test did not, by any means, substantiate the claims of the Perkins Engine Company as to the economy of the power plant, the fuel consumption during the test being 2.7 pounds of coal per indicated horsepower-hour rather than the 1.7 pounds reported by Mr. Bramwell in England. The Perkins Engine Company, however, insisted that the poor showing was caused by improper use of the steam jackets. After completion of the tests at Brooklyn, the *Anthracite* made a short trip to Providence and Newport and then went to Philadelphia, from which port she sailed for England, passing the Delaware River lightship on August

(*Continued on page 230*)





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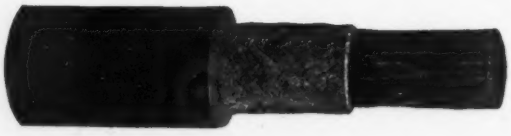

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HIGH-PRESSURE SALESMEN

(*Continued from page 228*)

22 and reaching Falmouth on September 14. Upon the return of the *Anthracite* to England, her power plant underwent another test which the company claimed substantiated their contention that her coal consumption did not exceed 1.7 pounds per indicated horsepower-hour.

Unfortunately, the benefit which the Perkins Engine Company hoped to realize from the voyage of the *Anthracite* was largely nullified by ill-advised and extravagant claims made in America by agents of the company as to the efficiency of her power plant. A bad impression was also made by the failure of the Perkins company to respond to a suggestion made by the Herreshoffs of Bristol, R. I., in a letter published in *Forest and Stream*. This read as follows:

We will be pleased to enter upon a friendly competition against the Perkins system of boilers and engines on board the *Anthracite* with our own coil boiler and compound engines on board the steam yacht *Leila*, upon such terms and conditions as may be mutually agreed upon. We hope, therefore, that an early reply to our proposition may be received from the owner or agents of the steamer *Anthracite*, as the questions of economy and speed are of vital importance to all steam users, and a better opportunity of determining to what extent steam can be expanded at a saving in fuel may not again be offered than during the stay of the *Anthracite* in our waters.

Very respectfully,
THE HERRESHOFF MANUFACTURING COMPANY

To this invitation the Perkins agents replied with a polite refusal, stating that the different size and power of the yachts made such a test impracticable. To engineers

(*Concluded on page 232*)

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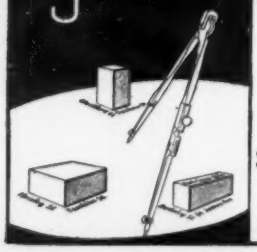

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HIGH-PRESSURE SALESMEN

(*Concluded from page 230*)

this was obviously an attempt to avoid what seemed to be a worth-while competitive test and undoubtedly the Herreshoff Company was justified in replying as follows:

To Major George Deane, Secretary,
Perkins Engine Company.
Dear Sir:

Yours of July 28th is received. We regret your declination of a practical test between the *Anthracite* and *Leila*. Although we recognize and appreciate the difference between the two vessels in point of speed, we still fail to see why a satisfactory test at the dock, if preferred, of twelve hours or more, could not be made, and the results so far as economy is concerned (it being a simple question of coal and horse power), be taken as reliable and convincing.

With the earnest wish that a fair and satisfactory trial may be still arranged, we remain,

Yours truly,
THE HERRESHOFF MANUFACTURING COMPANY

After the publication of these letters, *Forest and Stream* took up the question of the economy of the Perkins engine editorially and no doubt convinced yachtsmen of the extravagance of many of the claims made by agents of Perkins in America. At any event, no American firm appears to have purchased the right to build Perkins engines and boilers in the United States, and the voyage of the *Anthracite* as a promotion scheme must be reckoned a failure.

Though three generations of the Perkins family failed to develop their high-pressure steam engines and boilers to a state of perfection which could lead to the general acceptance of their system, we cannot but admire their faith in an idea which they felt to be fundamentally sound and which, in the light of recent developments in steam engineering, undoubtedly had merit. They should be remembered among the pioneers of high-pressure steam.

THE TREND OF AFFAIRS

(*Concluded from page 194*)

Territories of Canada. Discovered in 1930, the deposits had been actively developed before war made radium of even greater importance than usual by requiring it for treatment of instrument dials in night-flying planes. For each gram of radium extracted, the Canadian ores also yield 7,800 pounds of uranium. ¶ Paper has been adapted to become a substitute for wiping rags by the Navy. Tests show the new material to be superior to cloth for some purposes, though less speedy in the absorption of oil. Yearly, the Navy uses 65,000,000 pounds of wiping rags; 20,000,000 pounds of the paper substitute are expected to be used in 1944. ¶ From the pulp and seed which are waste products of cranberry jam factories, ursolic acid, a valuable emulsifying agent, is at present being extracted. Also recovered are cranberry wax and cranberry seed oil, both of which are commercially useful. ¶ Exploration along newly constructed sections of the Pan American Highway is proving fruitful; recently discovered 50 miles south of San José in Costa Rica is a fine stand of oak which is expected to produce 60,000 board feet to the acre. The trees run as large as eight feet in diameter, and have trunks 80 feet tall.

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THE INSTITUTE GAZETTE

(*Concluded from page 210*)

experiments conducted by Dr. Clark in her search for the soundest wire and the best metals for use in high-speed telegraph apparatus. One of her jobs is to select materials which are wear resistant and vibration proof. She works with complicated machines which magnify metals 2,500 times, so that she can find what stress and strain they can stand and perhaps develop better alloys for use in the important work of transmitting messages to the world.

In addition to her work with Western Union, whose metallurgical laboratory she founded in 1926, Dr. Clark is now serving as an engineering consultant for the War Department at the Frankford Arsenal, Philadelphia, Pa.

Dr. Clark has received a United States patent for electrical contacts suitable for high-speed service, British and French patents for steel, and two United States patents for a hardenable steel for such articles as dies, gears, cams, and tools. She has written many articles for the *Transactions* of the American Institute of Mining and Metallurgical Engineers, including: "A Study of the 470° C. Transition Point in Cast 60:40 Brass," in 1927; "A Study of the Heat Treatment, Microstructure and Hardness of 60:40 Brass," also in 1927; "Developments in Fatigue, Creep, Age-Hardening, Diffusion, Microscopy, Borocarbides, Powders, Electrode-Position and Die Castings," in *Mining and Metallurgy* in 1940; and "Metallurgical Problems in the Telegraph Industry," in *Mining and Metallurgy* in 1942.

In "American Men of Science" Dr. Clark is rated as an expert on nonferrous metallurgy and in copper alloys. She is a member of two committees of the American Institute of Mining and Metallurgical Engineers — those on rare and precious metals and on mining and metallurgy. She is also a member of the American Society for Metals and the New York Academy of Sciences.

A native of Glasgow, Del., Dr. Clark received an A.B. from Syracuse University in 1921, and then came to M.I.T. to study in Course III, from which she received the S.M. in 1922 and Sc.D. in 1926. She was a member of the Institute's instructing staff in the Department of Chemistry from 1921 to 1926. After receiving her doctor's degree, she entered the engineering department of the Western Union Telegraph Company, which was much impressed by her doctor's thesis, entitled, "A Study of the Heat Treatment, Microstructure and Mechanical Properties of 60:40 Brass."

Dr. Clark in private life is the wife of Robert L. Dietzold, '25. She is a member of the Cosmopolitan Club of New York and of the Appalachian Mountain Club. Her hobbies are skiing and mountain climbing and the study of early lead, copper, and steel.

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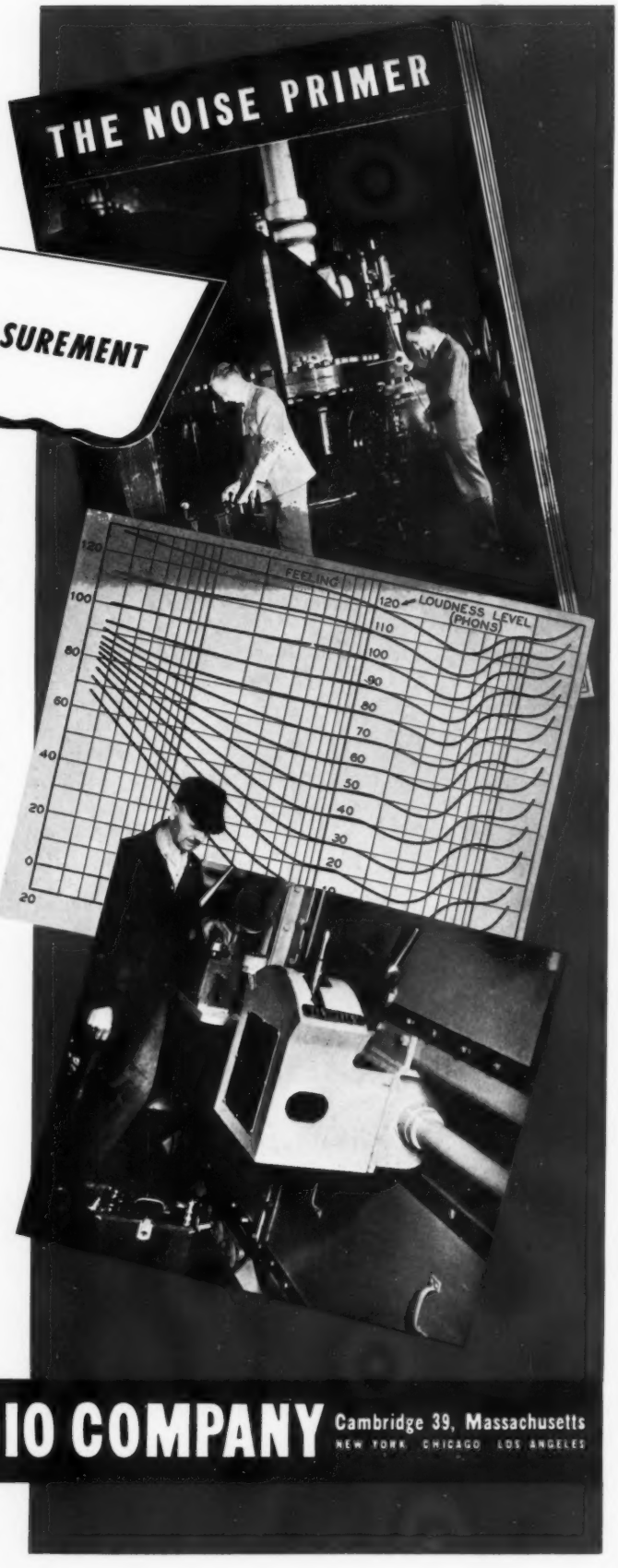

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